JAN 22 1917
LIBRARY

Volume VII No. [illegible] DECEMBER, 1916

$2.50 a Year
30c. Per Copy

THE JOURNAL
OF
Educational Psychology

INCLUDING EXPERIMENTAL PEDAGOGY, CHILD PHYSIOLOGY AND HYGIENE, AND EDUCATIONAL STATISTICS

EDITORS:

W. C. BAGLEY,
University of Illinois.

J. CARLETON BELL, Managing Editor,
Brooklyn Training School for Teachers.

C. E. SEASHORE,
University of Iowa.

GUY MONTROSE WHIPPLE,
University of Illinois.

PUBLISHED MONTHLY, EXCEPT JULY AND AUGUST.
WARWICK & YORK, INC.,
LANCASTER, PA. BALTIMORE, MD.

[Entered as second-class matter at the postoffice at Lancaster, Pa. under the Act of March 3, 1879.]

COLLABORATORS

SYDNEY ALBUTE,
University of Upsala, Sweden.

J. R. ANGELL,
University of Chicago.

J. W. BAIRD,
Clark University.

BIRD T. BALDWIN,
Swarthmore College.

W. VAN DYKE BINGHAM,
Carnegie Institute of Technology.

E. F. BUCHNER,
Johns Hopkins University.

W. H. BURNHAM,
Clark University.

ED. CLAPARÈDE,
University of Geneva, Switzerland.

S. S. COLVIN,
Brown University.

W. F. DEARBORN,
Harvard University.

H. H. GODDARD,
New Jersey Training School, Vineland, N. J.

JOSEPH JASTROW,
University of Wisconsin,

G. E. JOHNSON,
Harvard University.

E. A. KIRKPATRICK,
State Normal School, Fitchburg, Mass.

E. H. LINDLEY,
University of Indiana.

ANNA J. MCKRAO,
Wellesley College.

D. P. MACMILLAN,
Board of Education, Chicago, Ill.

D. R. MAJOR,
Columbus, Ohio.

ADOLF MEYER,
Johns Hopkins University.

J. B. MINER,
Carnegie Institute of Technology.

WILL S. MONROE,
State Normal School, Montclair, N. J.

E. C. MOORE,
Harvard University.

HUGO MÜNSTERBERG,
Harvard University.

M. V. O'SHEA,
University of Wisconsin.

W. B. PILLSBURY,
University of Michigan.

S. H. ROWE,
Principal Wadleigh High School, New York City.

SANTE DE SANCTIS,
University of Rome, Italy.

E. C. SANFORD,
President of Clark College.

W. S. SMALL,
Principal of Eastern High School, Washington, D. C.

E. D. STARBUCK,
University of Iowa.

L. WILLIAM STERN,
University of Breslau, Germany.

G. M. STRATTON,
University of California.

G. D. STRAYER,
Columbia University.

E. L. THORNDIKE,
Columbia University.

E. B. TITCHENER,
Cornell University.

J. B. WATSON,
Johns Hopkins University.

W. H. WINCH,
London, England.

H. K. WOLFE,
University of Nebraska.

A. H. YODER,
State Normal School, Whitewater, Wis.

HEADQUARTERS

FOR

EVERYTHING PSYCHOLOGICAL

No Middleman's Profit *Direct from Factory to Consumer*

SEASHORE'S AUDIOMETER

No. 7376 - $85.50 net

A high grade instrument designed to eliminate the measurement of sound stimulus in terms of "my watch" or "my voice." Constructed on scientific principles to meet the requirements of the school room, psychological laboratory and the aurist's office. Particulars on request.

C. H. STOELTING CO.

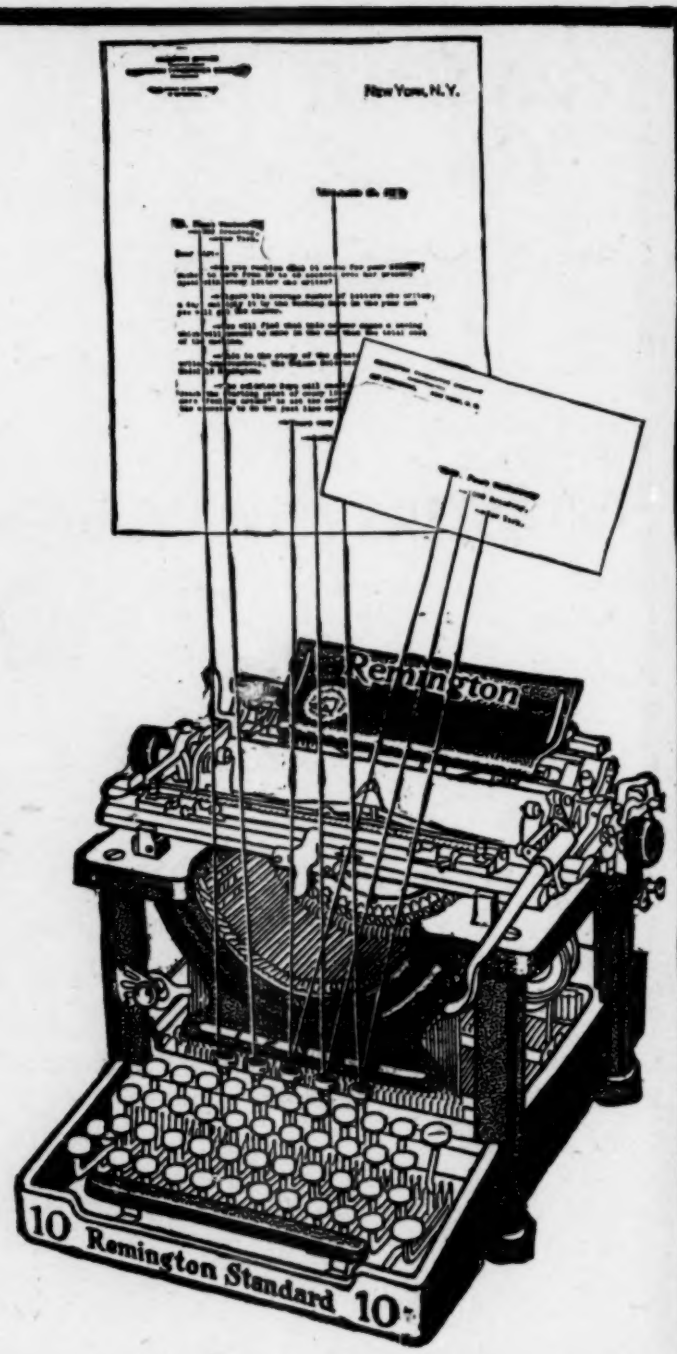
Manufacturers, Importers and Exporters of

SCIENTIFIC APPARATUS AND LABORATORY SUPPLIES

3037-3047 Carroll Ave. Chicago, Ill., U. S. A.

Up-To-Date Training

is what every pupil needs. Up-to-date training in typewriting means training on the up-to-date machine; the machine which represents the very latest idea in typewriter progress. This machine is the



Self Starting REMINGTON TYPEWRITER

The new Self Starting Remington embodies a new feature which has perfected the science of touch typewriting; which has added from 15% to 25% to the efficiency of the typist.

A Remington invention. Nothing else like it. Write us for an illustrated folder telling all about the Self Starting Remington.

REMINGTON TYPEWRITER COMPANY
(Incorporated)
327 Broadway New York

Questions! Questions! Questions!

Bright active pupils constantly ask questions. If your school does not have a large dictionary *why* not bring its equipment up to maximum efficiency with the *"One Supreme Authority,"*—

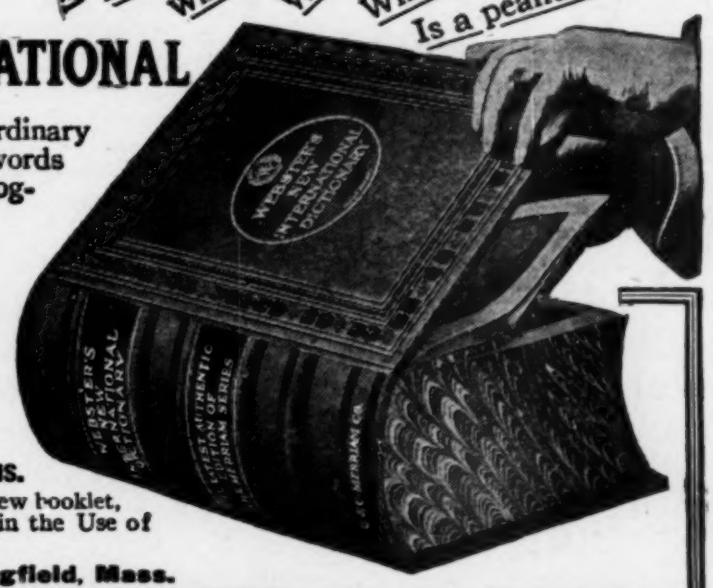
What is hardpan?
What is a chemical element?
What is felt?
What is a werewolf?
What is tufa?
What is a Musca?
What is a xebec?
How is *Przemysl* pronounced?
What is a sun spot?
What is the source of cork?
What is a *continuous voyage*?
How is cloth mercerized?
What is a satellite?
Where is *Saloniki*?
Who were the Janizaries?
What is demurrage?
What are the halogens?
Is a peanut a nut?

WEBSTER'S NEW INTERNATIONAL

This great book not only answers the ordinary questions of spelling and pronunciation for words old and new, but unlocks the doors of biography and geography, art and science.

The Best Gift to Select.

It will be admired, treasured, and used long after the holiday season has passed. A daily reminder of the giver.



400,000 Words. 30,000 Geographical Subjects.
12,000 Biographical Entries. 6000 Illustrations.
2700 Pages.

REGULAR and INDIA-PAPER EDITIONS.

Write for specimen pages, etc. **Free, to Teachers,** a new booklet, "Unlocks the Door," containing twenty-one Lessons in the Use of Merriam-Webster Dictionaries.

G. & C. MERRIAM CO., Springfield, Mass.

For the Professional Library

A New Educational Publication

There are undoubtedly a score of arts that every teacher should know how to practice in instructing a class. Class teaching without the mastery of these arts is bound to result in failure. In practise, however, some of these arts are more important than others. Here are to be mentioned—

The art of story-telling, the art of questioning, and the art of studying

The teacher who is a master of these three arts can safely, in the beginning at least, disregard the minor arts of instruction.

STORY-TELLING, QUESTIONING, AND STUDYING

by Herman Harrell Horne is a simple comprehensive treatment of the theory and practice of these three school arts.

Published Nov. 8, 1916 *$1.10*

THE MACMILLAN COMPANY

NEW YORK BOSTON CHICAGO SAN FRANCISCO DALLAS ATLANTA

Recent Books Widely Approved

Lewis & Hosic's Practical English for High Schools

By WILLIAM D. LEWIS, Principal of William Penn High School for Girls, Philadelphia, and JAMES FLEMING HOSIC, Managing Editor The English Journal, Head of Department of English, Chicago Normal College, Chicago.

Entirely free from moss-grown traditions, this freshly-built text-book reaches the acme of efficiency in English training. It discards the four forms of discourse so long used: *Narration* is here transformed into "Telling a Story"; *Exposition* becomes "Making People Understand," *Argumentation*, "Making People Believe." *Description* is treated as an accessory.

English as a means of communication, not as a cultural attainment, is the aim of the book. It develops the pupil's initiative; it is keen, alive and dynamic. One experienced teacher says of it: "It strikes me as the best textbook on High School English—a conviction I express deliberately and sincerely. It is *practical* and it is for *High Schools*."

Hotchkiss & Drew's Business English

By GEORGE BURTON HOTCHKISS, M. A., Professor of Business English, New York University School of Commerce, Accounts and Finance, and CELIA ANNE DREW, Ph. D., instructor in English, Julia Richman High School, New York.

The essentials of good English are emphasized, especially sentence structure and diction. There is abundant practice in common business forms and usages, such as the make-up of a letter, remittances, etc. Valuable training in business courtesy is given. Sales letters, advertisements, and reports are also included.

Hunt's Community Arithmetic

By BRENELLE HUNT, Principal of the Training School Department, State Normal School, Bridgewater, Mass.

The wage earning problem most pupils must face has been kept clearly in mind by the author. Enough practice is given in each of the subjects to develop some degree of proficiency. Actual business conditions are represented in the lessons.

The lines of work taken up include the Buying and Selling of Meat, Groceries, Dry Goods, Shoes, Coal, and Furniture, the Keeping of Poultry Accounts, Carpentering, Building Problems, Saving and Investing Money. *For Use in Junior High Schools or Upper Grammar Grades.*

AMERICAN BOOK COMPANY

New York Cincinnati Chicago Boston Atlanta

VOLUME VII DECEMBER, 1916 NUMBER 10

THE JOURNAL OF
EDUCATIONAL PSYCHOLOGY

A PRELIMINARY STUDY OF THE MEASUREMENT OF ABILITIES IN GEOMETRY

L. V. STOCKARD
Texas State Department of Education
AND
J. CARLETON BELL
Brooklyn Training School for Teachers

INTRODUCTORY

The past five or six years have witnessed a very promising activity in the experimental study of the abilities of elementary school pupils, in the construction of scales to measure attainments in elementary subjects, and in the application of these scales to evaluate progress in school work, but as yet very little attention has been paid to the accomplishments of pupils in secondary school subjects. The studies of Monroe,[1] Rugg[2] and Childs[3] in algebra; of Hanus[4] in Latin, and of T. L. Kelley[5] in his monograph on *Educational Guidance* include practically all of the experimental work that has been reported. Yet there is no period of intellectual development in which individual differences are more marked, or in which more careful account needs to be taken of these differences for the best interests of the child's progress in school work than the high school period. School authorities have paid much attention to the differentiation of the curriculum to meet various needs, but have given little thought

[1] WALTER S. MONROE. *A Test of the Attainment of First Year High School Students in Algebra.* School Review, 23: 1915, 159–171.
[2] H. O. RUGG. *The Experimental Determination of Standards in First Year Algebra.* School Review, 24: 1916, 37–66.
[3] H. G. CHILDS, University of Indiana. (Unpublished.)
[4] PAUL H. HANUS. *Measuring Progress in Learning Latin.* School Review, 24: 1916, 342–351.
[5] TRUMAN LEE KELLEY. *Educational Guidance: An Experimental Study in the Analysis and Prediction of Ability of High School Pupils.* Teachers College Contributions to Education, No. 71, 1914. Pp. 116.

to the aptitudes of pupils, or their fitness for and success in the different subjects that they take. Particularly in geometry would it seem that experimental studies in the progress of pupils and in the profit derived from their course are called for. The study of geometry is generally required of high school pupils for at least one year. Of all the arguments made in defense of this requirement the plea of "formal discipline" has undoubtedly had the greatest weight. It is traditionally accepted that no school subject has such efficacy in "training the reasoning faculty" as geometry. No matter how severe the buffetings that "formal discipline" may receive at the hands of experimental psychology, this idea is firmly fixed in the minds of school administrators and of intelligent laymen. Such a traditional belief challenges experimental study.

But before much progress can be made in determining the degree to which the study of geometry develops reasoning in other lines, we need to know more definitely how pupils who have taken the ordinary high school work in geometry react to geometrical situations themselves. It was in the hope of throwing some light on the latter question that the present study was undertaken. In the field of experimental studies bearing on abilities in geometry, Metzler[6] and Yocum[7] have suggested a number of problems that might profitably be investigated, but have made no researches themselves. Kelley, in the study mentioned above, used a geometry test containing ten questions. One of these required imagery of the results of a cut in a folded paper, five were simple locus problems involving no knowledge of geometry, one was a ratio problem, and three were problems in syllogistic logic. To what extent such exercises are indicative of ability in geometry is a question which need not be discussed here. As the study was one in correlation, the gross results of the tests were not indicated. Courtis[8] has devised a number of reasoning tests which can be given to pupils who are about to take up geometry, and which may furnish indication of ability in the subsequent study of the subject, but no results of their application are at hand.

The authors are keenly aware of the incompleteness and inconclusiveness of the present study. It was their intention to give the data a more adequate and detailed statistical treat-

[6] W. H. METZLER. *Problems in the Experimental Pedagogy of Geometry.* Journal of Educational Psychology, 3: 1912, 545–560.

[7] A. DUNCAN YOCUM. *A First Step in Inductive Research into the Most Effective Methods of Teaching Mathematics.* School Science and Mathematics, 13: 1913, 197–210.

[8] S. A. COURTIS, Detroit, Mich. (Unpublished.)

ment, but through an unfortunate accident the original papers were lost, and it was thought best to publish the results already worked out.

Construction of the Tests

In devising the list of questions for the test the attempt was made to call for information that is to be found in all standard text books; to test for important and fundamental principles of geometry; to provide such a range of questions as to be representative of the whole field of elementary geometry, and include memory facts, knowledge of context, organization of subject matter, and power to do "originals"; and to confine the list to such dimensions that every question could be tried by the average high school pupil in a period of forty minutes. These demands are not easy to fulfill, and it was subsequently found that the list finally adopted was too long for the slower workers.

A preliminary set of questions was drawn up, submitted to the criticisms of professors of mathematics, high school teachers of mathematics, and advanced students of education, and tried on four classes of high school pupils. On the basis of these criticisms and results the list was revised and printed in the following final form:

The Questions

School ..... Date ..... Time used.....

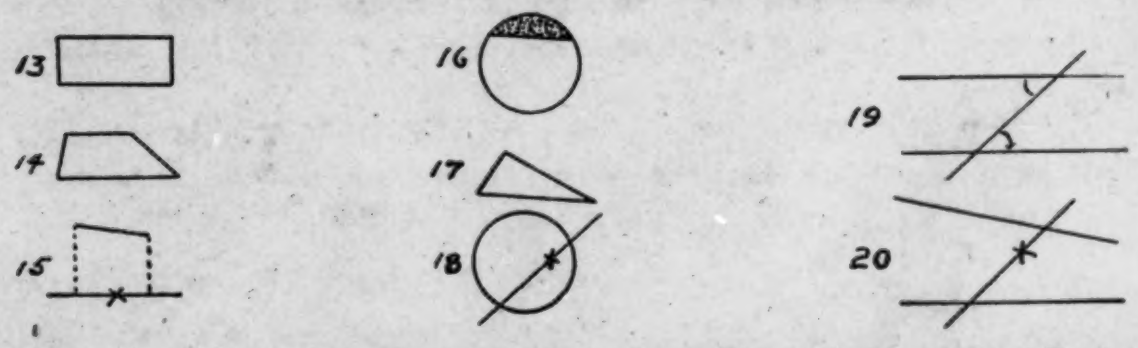
Pupil ..... Age ..... Sex ..... Grade .....

Take the following questions in the order given, omitting none. Place a cross (X) after any question you consider but can not answer. In case you do not finish, draw a line under the last number considered. Make your answers brief but clear. Do not use the left hand margin.

I. Draw small freehand figures *after* each of the following terms to illustrate its meaning:

1. Circle
2. Rhombus
3. Square
4. Hexagon
5. Angle
6. Sector
7. Tangent
8. Chord
9. Diagonal
10. Transversal
11. Central angle
12. Inscribed angle

II. Write after each figure its name or the name of the marked part:



III. 21. Indicate the order in which the propositions relating to the following areas should be developed: Circle, triangle, parallelogram, rectangle, regular polygon.

(1) (2) (3) (4) (5)

IV. Complete the statement of the following:

22. The line joining the mid points of two sides of a triangle. . .

23. The diagonals of a parallelogram. . .
24. If from a point without a circle a secant and a tangent are drawn. . . .
25. The bisector of an interior angle of a triangle divides the opposite side. . . .
26. Line segments are equal, if they are
    (a)
    (b)

V. State the *converse* of each of the following, and tell whether it is true by writing "yes" or "no" after what you have written:

27. If two lines in the same plane are cut by a transversal so that the alternate-interior angles are equal, the lines are parallel.
28. The diagonals of a rectangle are equal.

VI. Define accurately:

29. Parallelogram.
30. Circle.

VII. 31. Name five regular polygons which you have learned to inscribe in a circle:
(1) (2) (3) (4) (5)

VIII. 32. Name the parts of a theorem:
(1)
(2)

33. Outline the steps in an *indirect proof:*
(1)
(2)

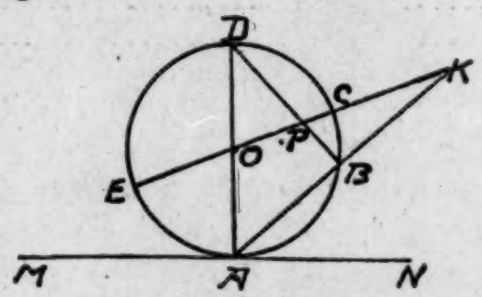
IX. Solve:

34. In a certain right triangle the acute angles are 2x and 7x. Find the value of each acute angle.
35. What is the angle whose supplement is three times its complement?

X. 36. The area of a trapezoid is equal to half the sum of its bases by its altitude. (Draw figure and prove in full. Work may be shortened by using algebraic methods.)

XI. In a regular polygon of n sides, *indicate* how many degrees in:

37. The sum of the interior angles.
38. The sum of the exterior angles.
39. One interior angle.
40. One exterior angle.



XII.

Given: O the center of the circle, arc AB=70°, arc DC=80°. Find the number of degrees in the following angles:
(Hint.—How many degrees in arc BC? In arc AE?)

41. Angle EOA
42. Angle BAN
43. Angle BAD
44. Angle EKA
45. Angle BPC

XIII. 46. Indicate by drawing small freehand figures and by marking the necessary lines and angles (or by the use of letters) the general cases of the congruency of triangles:
(1)
(2)
(3)

XIV. 47. State three cases of the similarity of two triangles:
(1)
(2)
(3)

XV. 48. What two conditions are necessary and sufficient to show that a line or group of lines is a required locus?
(1)
(2)
49. Draw or describe the locus of a point one-half inch from a given circle with radius *r*.
50. What is the locus of points equidistant from the sides of a given angle? (Draw figure.)
51. What is the locus of the vertex of the right angle C of a right triangle constructed upon a given hypotenuse AB? (Draw figure.)

XVI. 52. Draw a small triangle and then draw the auxiliary lines (dotted lines) needed in proving that the sum of the angles of the triangle is equal to 180 degrees.
In an *auxiliary construction:*
53. How far is a line usually produced?
54. Into how many parts is a line or angle usually divided?
55. Is a line often drawn otherwise than parallel or perpendicular to some prominent line of the figure?

XVII. Show by small freehand figures how to make the following constructions:
56. The perpendicular bisector of a line.
57. A circle inscribed in a triangle.
58. The division of a line into three equal parts.
59. The construction of a square equivalent to two given squares.

XVIII. 60. Find a mean proportional to 4 and 16.
61. Find a fourth proportional to 3, 5, and 6.
62. Find a third proportional to 4 and 6.
63. What is the ratio of two similar polygons whose corresponding sides are 5 and 7?
64. What is the ratio of the perimeters of the two polygons in (63)?

XIX. Write an algebraic formula to express each of the following areas:
65. A parallelogram with base a and altitude h.
66. A rectangle with sides a and b.
67. A triangle with base a and altitude h.
68. A trapezoid with bases a and b, and altitude h.
69. A circle with radius r.

XX. 70. Name in proper order the steps that must be taken to construct a square equivalent to any given polygon:
(1)
(2)

It will be noticed that the questions are numbered consecutively from 1 to 70, and that they are arranged in twenty groups. These groups involve drawing figures, naming figures, indicating order of development in demonstration, completing statements, stating the converse, definitions, regular polygons, parts of a demonstration, angular relations, area of a trapezoid, angles in polygons, angles in circles, congruency of triangles, similarity of triangles, loci, auxiliary lines, simple constructions, ratio and proportion, algebraic expression of geometrical relations, and equivalent construction.

The Results

Results were obtained from classes in four representative Texas high schools, one class in a normal school, and one section of the freshman class in the University of Texas. In all 372 papers were

received. In the high school from which the largest number of returns were received one of the writers (Stockard) conducted the test in person, in the other schools the test was given by the regular teachers. The accompanying figures, with the exception of Figure II, give data for high schools only. The results from the normal school were similar to those from the high schools, except that they were slightly higher, while those from the University were appreciably lower. The probable reason for this is that the university students were farther removed from their study of plane geometry than the normal and high school pupils. All of those tested had had one year of plane geometry, but some had just finished it, while others had taken the work one or two years previously. In the latter case they had continued with some sort of mathematics, or all those tested (except the university freshmen) were in mathematics classes.

In tabulating the results all questions were regarded as having equal value, and were counted as "right" "wrong," or "not attempted." Inspection of Table I and Figure I, however, shows great inequality in the difficulty of the questions, and points to the need for a "weighted" score.

Table I shows the total number of high and normal school pupils attempting each problem, the number of pupils answering each problem correctly, and the percentage of correct replies. It will be noted that the dropping off in the number attempting the problems is due chiefly to the time limit. This disturbs the significance of the percentages in the later problems to some extent, since it is evident that we have to do with a more and more highly selected group of speedy workers. If the speedier workers are also the more accurate workers, the percentages are higher on the later problems than they would have been if all the pupils had been given time enough to attempt all the problems. But are the speedier workers also the more accurate? An attempt to check this up on the basis of the first thirty problems (which were attempted by practically all the pupils) showed that this was not the case,—that the speedy workers made about as many mistakes as the slow ones. In the absence of evidence to the contrary, therefore, we shall assume that the percentages, even on the later problems, fairly represent the relative difficulty of the problems.

If we assume that the distribution of abilities in these tests corresponds to the normal distribution curve, we may transform

TABLE I.

Scores of Normal and High School Pupils

No. of Problem	No. of Pupils Attempting Problem	No. of Correct Solutions	Per cent. Correct	P. E.	P. E. Units	Weightings	No. of Problem	No. of Pupils Attempting Problem	No. of Correct Solutions	Per cent. Correct	P. E.	P. E. Units	Weightings
1	351	351	100.0	—5.00	1	.003	36	336	172	51.2	— .05	495	1.5
2	351	225	64.2	— .54	446	1.4	37	307	82	26.7	+ .93	593	1.8
3	351	351	100.0	—5.00	1	.003	38	304	56	18.4	+1.33	633	2.0
4	351	341	97.2	—2.81	219	.7	39	303	60	19.8	+1.26	626	2.0
5	351	350	99.9	—4.60	40	.124	40	302	40	13.3	+1.65	665	2.1
6	351	147	41.9	+ .30	530	1.7	41	295	164	55.6	— .22	478	1.5
7	351	348	99.1	—3.50	150	.47	42	294	127	43.2	+ .25	525	1.6
8	351	332	94.6	—2.38	262	.8	43	293	109	37.3	+ .48	548	1.7
9	351	340	96.9	—2.78	222	.7	44	290	74	25.5	+ .98	598	1.9
10	351	340	96.9	—2.78	222	.7	45	286	47	16.4	+1.51	651	2.0
11	351	337	96.0	—2.60	240	.8	46	280	227.3	81.1	—1.31	369	1.2
12	351	314	89.6	—1.90	310	1.0	47	269	166.6	61.9	— .45	455	1.4
13	351	296	84.4	—1.50	350	1.1	48	253	113	44.7	+ .20	520	1.6
14	351	216	61.6	— .44	456	1.4	49	245	76	31.5	+ .71	571	1.8
15	351	181	51.6	— .06	494	1.5	50	241	105.5	43.8	+ .23	523	1.6
16	351	90	25.6	+ .97	597	1.9	51	234	28.5	12.2	+1.74	674	2.1
17	351	329.5	93.7	—2.27	273	.9	52	219	102	46.6	+ .15	515	1.6
18	351	216	61.6	— .44	456	1.4	53	213	12	5.6	+2.35	735	2.3
19	351	264	75.3	—1.02	398	1.2	54	207	121	58.5	— .31	469	1.5
20	351	303	86.4	—1.63	337	1.1	55	206	127	61.6	— .44	456	1.4
21	351	131	37.3	+ .48	548	1.7	56	201	95	47.3	+ .11	511	1.6
22	351	189.5	54.0	— .15	485	1.5	57	198	81	40.9	+ .34	534	1.7
23	351	233.5	66.4	— .68	432	1.3	58	193	109	56.5	— .24	476	1.5
24	350	186.5	53.2	— .14	486	1.5	59	190	73	38.4	+ .44	544	1.7
25	350	125.5	35.9	+ .54	554	1.7	60	165	89.5	54.3	— .16	484	1.5
26	350	130.5	37.3	+ .48	548	1.7	61	161	80.5	50.0	0	500	1.6
27	350	248.5	70.9	— .82	418	1.3	62	158	49.5	31.3	+ .72	572	1.8
28	350	26.5	7.5	+2.13	713	2.2	63	154	40	25.9	+ .96	596	1.9
29	350	242.5	69.4	— .75	425	1.3	64	150	42	28.0	+ .86	586	1.8
30	350	228	65.2	— .57	443	1.4	65	143	109	76.3	—1.06	394	1.2
31	349	266	76.3	—1.06	394	1.2	66	141	122	86.6	—1.66	334	1.0
32	345	218.5	63.4	— .51	449	1.4	67	140	115	82.2	—1.37	363	1.1
33	345	77.5	22.4	+1.13	613	1.9	68	139	89	64.1	— .54	446	1.4
34	343	248.5	72.5	— .88	412	1.3	69	139	82.5	59.4	— .35	465	1.5
35	338	76	22.5	+1.12	612	1.9	70	131	30.5	23.3	+1.08	608	1.9

the percentages into values of P. E. by making use of Thorndike's table.[9] These values are indicated in the column marked P. E. in Table I. It should be noted that since problems 1 and 3 had 100 per cent. correct, it is impossible to calculate a P. E. value for them. Quite arbitrarily they were given the value —5.00 P. E., and in lieu of any zero point experimentally determined

[9] EDWARD L. THORNDIKE. *Mental and Social Measurements.* New York: Teachers College, Columbia University, 1913. P. 200.

for the tests their difficulty was set at 1 P. E. unit. The other difficulty measures in the column marked P. E. Units were found by multiplying the P. E. values by 100 and subtracting them from or adding them to the 500 units representing the assumed distance of Problem 1 from the median. These P. E. Units were then reduced to the basis of a scale of 100 points for the entire test, and each problem was given its proportionate weighting on such a scale, as is shown in the column marked "Weightings."

Figure I represents graphically the showing made on the entire set of seventy questions by the four high schools taking part in the test. "Per cent. right," as shown here, represents the number of pupils answering correctly, divided by the number of pupils taking part in the test from that school. With a few exceptions the curves parallel each other throughout.

Considering the results presented in Table I and Figure I somewhat more in detail, it is to be noted that, as one would expect, group I is on the whole the easiest, although questions 2 and 6 are of approximately median difficulty (the median in this array is problem 60, with a correctness percentage of 54.3, 484 P. E. Units, weighting 1.5). The term "central angle" (11) seems to be appreciably more familiar than "inscribed angle" (12). Hexagon (4), diagonal (9) and transversal (10) are equally familiar, but chord (8) is almost twice as difficult as tangent (7). That sector (6) and segment (16) both rank high in difficulty will not surprise teachers who have labored to get pupils to distinguish them. Group II is on the whole decidedly harder than group I, even the triangle giving considerable difficulty. In advance of the test the authors would not have guessed that the rectangle (13) was slightly less familiar than the transversal (20). Since question 10 and question 20 refer to the same thing it is interesting to note that the word (transversal) is much more readily illustrated than the object is named.

The hardest group was group XI (questions 37–40), having to do with the angles of regular polygons. The most difficult questions of all were 53, "how far is a line usually produced in auxiliary construction," and 28, "state the converse of the proposition the diagonals of a rectangle are equal." The first of these had only 5.6 per cent. correct answers and the second 7.5 per cent. Questions 51, "What is the locus of the vertex of the right angle C of a right triangle constructed upon a given

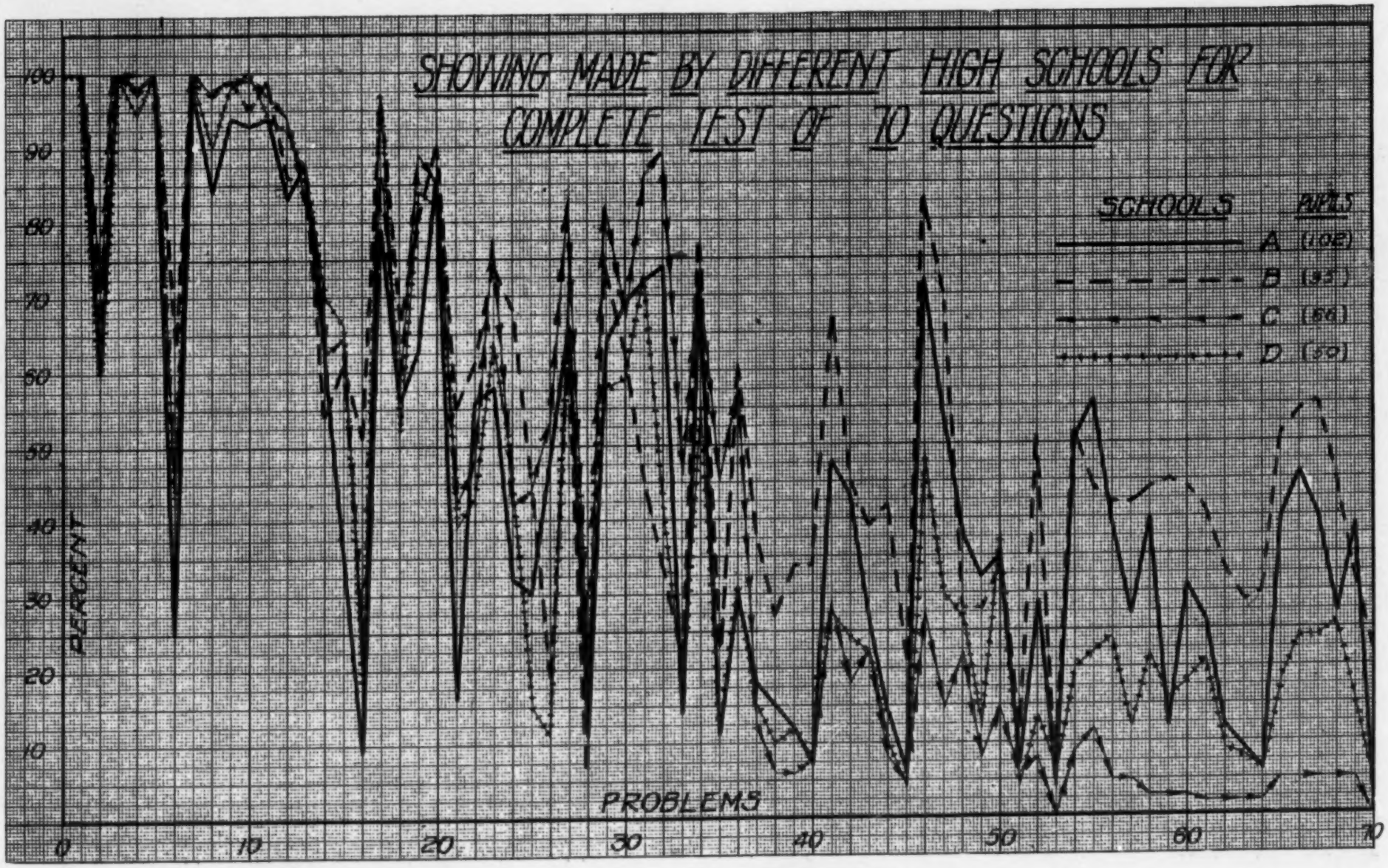

SHOWING MADE BY DIFFERENT HIGH SCHOOLS FOR COMPLETE TEST OF 10 QUESTIONS
SCHOOLS
PUPILS
A (102)
B (93)
C (66)
D (60)
PERCENT
100
90
80
70
60
50
40
30
20
10
PROBLEMS
0
10
20
30
40
50
60
70

FIGURE I

hypotenuse AB," 45, the angle formed by intersecting chords, 33, outlining the steps in an indirect proof, 35, "What is the angle whose supplement is three times its complement," and 70, the steps to construct a square equivalent to any given polygon, were also difficult.

Figure II represents the comparative scores made by boys and girls, considering the total number of pupils from the high schools and the normal school, and plotting the values for numbered groups of problems instead of for separate questions. The close proximity of the curves seems to indicate that geometry abilities in boys and girls are about equal. Only in groups VII, IX, X, and XII do we find an appreciable difference. In general the boys are slightly in the ascendancy, being surpassed by the girls only in groups X, XIII, XVIII and XIX.

In Figure III are shown the results from two classes of girls, one the high 10 the other the low 11. Both had had the regular work in plane geometry in high 9 and low 10, and both were taking more mathematics, the high 10's solid geometry and the low 11's trigonometry. The low 11's are the smaller and more highly selected group, all of them taking mathematics because they like it. Yet they are by no means uniformly superior in these tests. Their chief superiority is found in groups V and VII, while in the hardest group, XI, they fall far below their younger sisters.

From Figure IV it will be seen that there are marked differences in the per cent. of pupils continuing in the test, or rather in the number of pupils attempting the later problems. Schools A and B, the largest of those tested, kept very close together, and a fairly large percentage of the pupils attempted all the problems. Many pupils in school D were able to attempt only 30 to 35 problems in the 40 minutes, while school C dropped still lower and had no pupil who attempted all the problems in the time. It is noteworthy that school C has the highest "efficiency," as indicated in Figure VII, and from the average time indicated on the papers it would seem that the time was cut short for some reason.

Figure V enables us to compare several groups of boys and girls at varying distances from their work in plane geometry. Of two groups of girls those who have had the plane geometry most recently make the higher score. The preliminary test

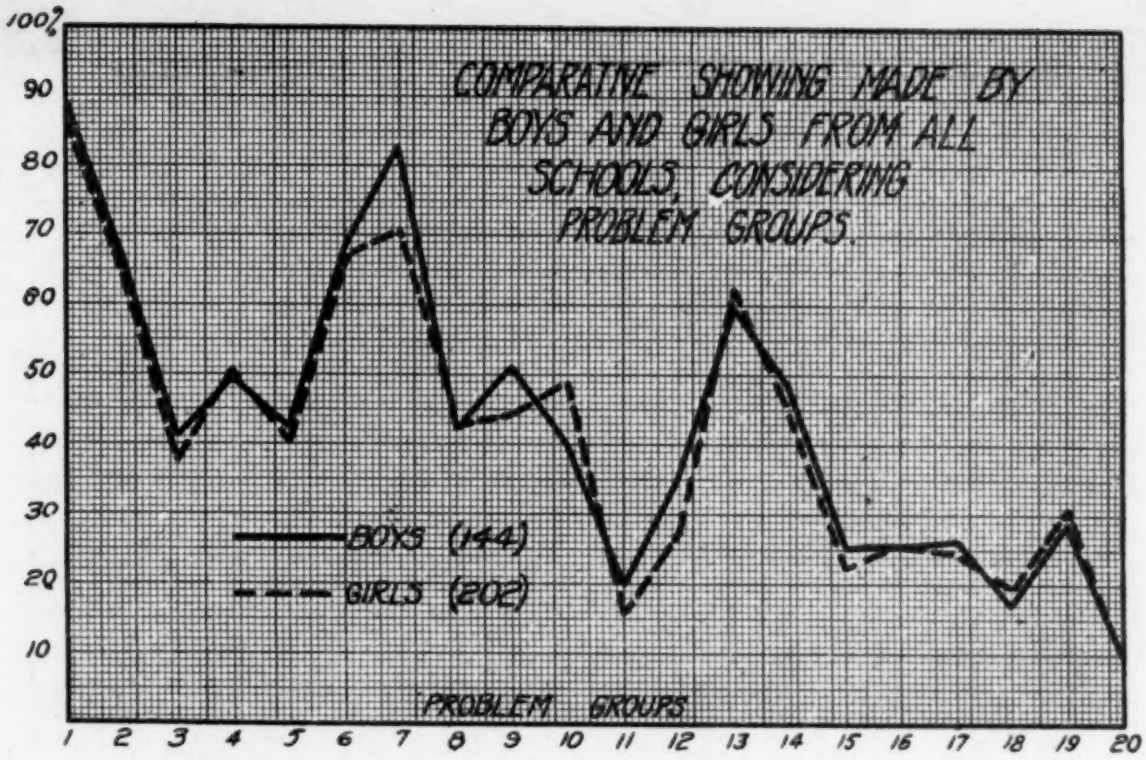


FIGURE II

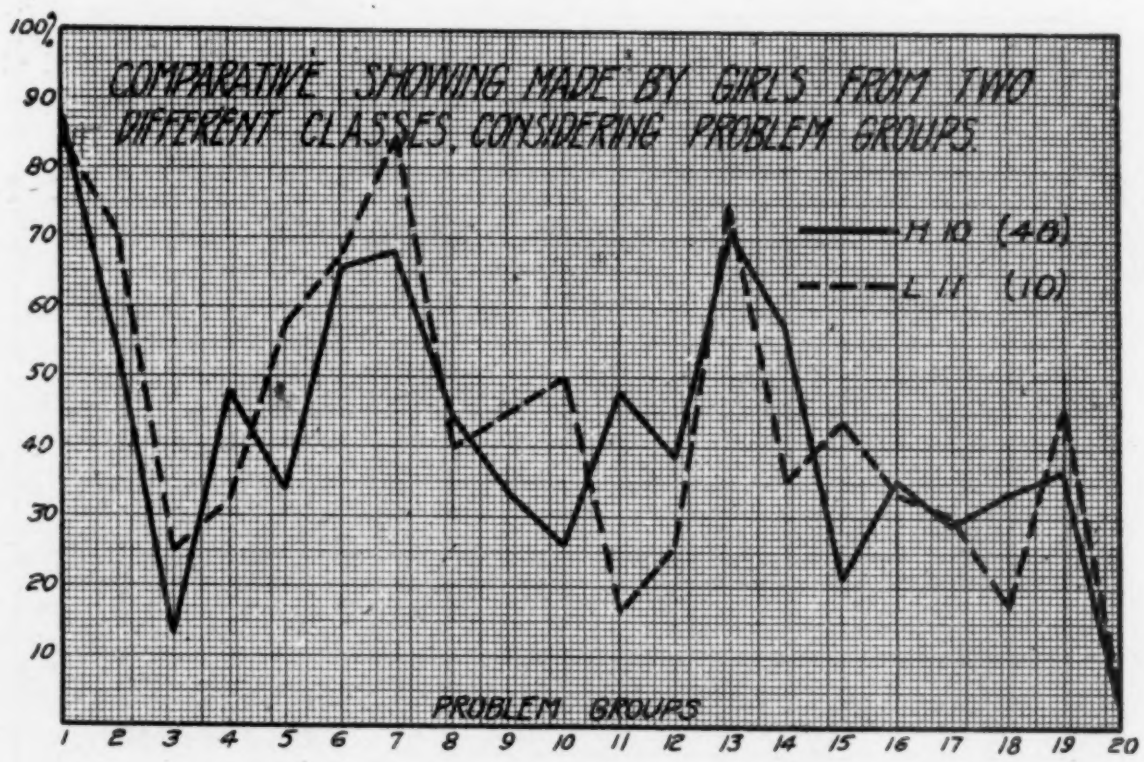


FIGURE III

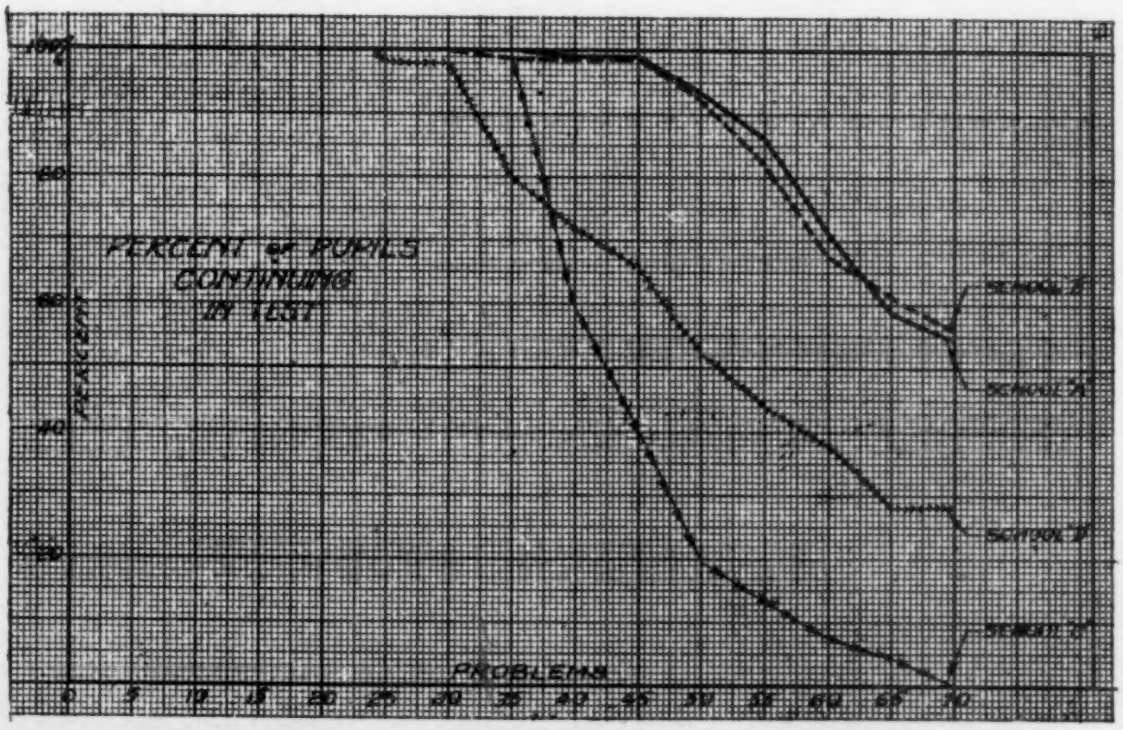


FIGURE IV

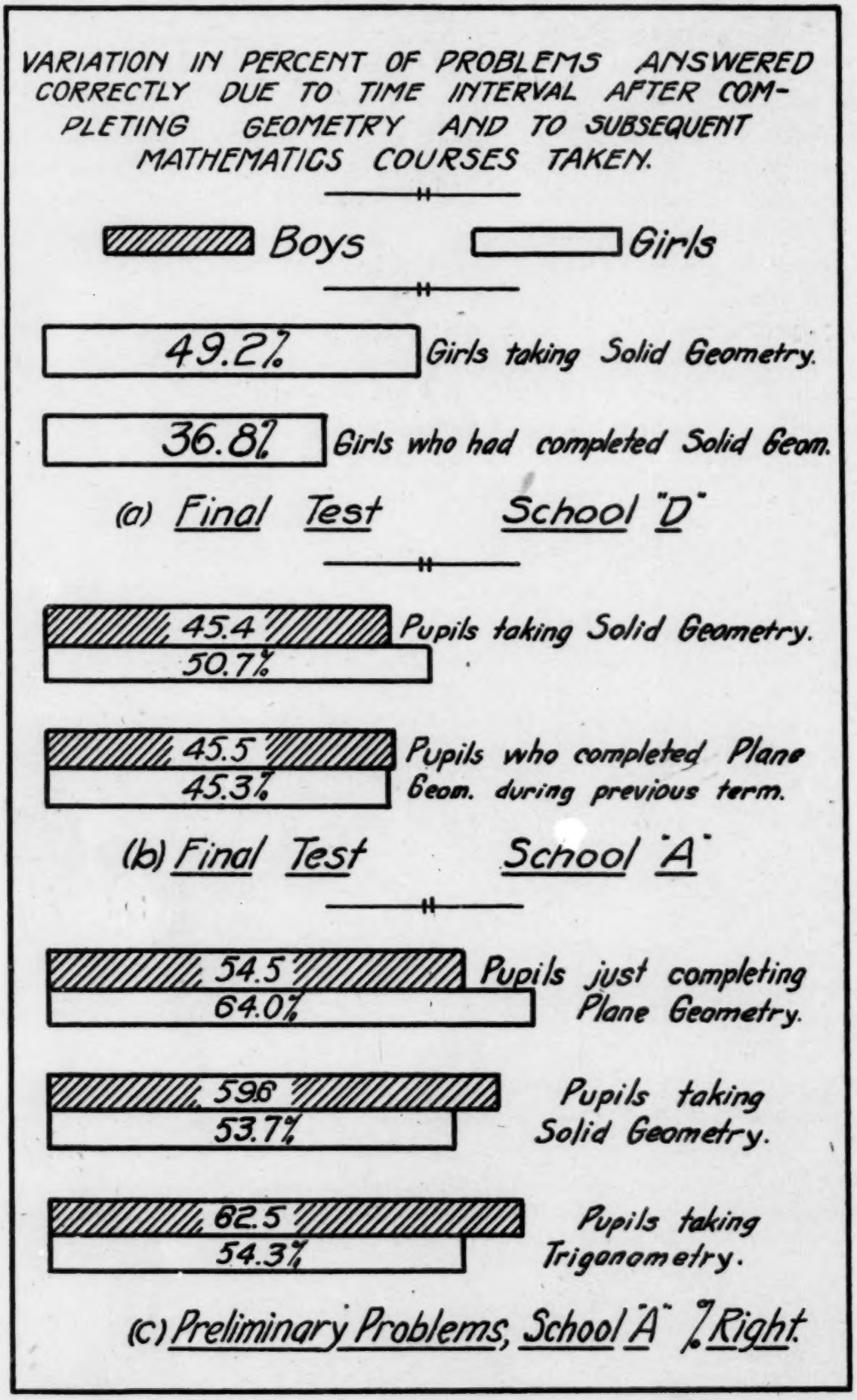

VARIATION IN PERCENT OF PROBLEMS ANSWERED CORRECTLY DUE TO TIME INTERVAL AFTER COMPLETING GEOMETRY AND TO SUBSEQUENT MATHEMATICS COURSES TAKEN.
Boys
Girls
49.2%
Girls taking Solid Geometry.
36.8%
Girls who had completed Solid Geom.
(a) Final Test School "D"
45.4%
50.7%
Pupils taking Solid Geometry.
45.5%
45.3%
Pupils who completed Plane Geom. during previous term.
(b) Final Test School "A"
54.5%
64.0%
Pupils just completing Plane Geometry.
59.6%
53.7%
Pupils taking Solid Geometry.
62.5%
54.3%
Pupils taking Trigonometry.
(c) Preliminary Problems, School "A" % Right.

FIGURE V

(see bottom of Figure V) seemed to point to the conclusion that immediately on finishing plane geometry the girls made the higher score, but as more and more time elapsed the boys took the lead and increased it. This suggested the generalization that the girls worked harder and could give a better account of themselves while studying the subject, but either because of less real insight into the meaning of geometry or less permanent interest in it their attainments deteriorated more rapidly with the lapse of time. In the final test in that same school, however, the relation is reversed, the boys doing a trifle better in the group that completed plane geometry during the previous term, and the girls doing markedly better in the group taking solid geometry. The settlement of this question, therefore, awaits further investigation.

Figure VI presents the test scores of twenty pupils chosen at random from two classes and their class grades in plane geometry and in advanced algebra. The test scores were arranged in descending order, and the class grades plotted accordingly. In general there is a close resemblance between the test curve and the geometry grade curve. The test curve drops a little more rapidly than the grade curve, but this is doubtless due to the fact that a teacher's grades tend to be buoyed up at the lower end by the consciousness of 75 as the passing mark.

Figure VII gives the per cent. attempted, the per cent. right, the per cent. wrong, and the per cent. "efficient" of each of the four high schools.

To any subsequent workers in this field the authors would suggest that it might be advantageous to restrict the number of questions so that all taking the test may be able to attempt every question; that it would be well to note the time each one takes on the test in order to determine whether the rapid workers are also the most accurate; and that each pupil be asked to write out a complete record of his work in mathematics in order to furnish material for a more thorough-going evaluation of the results.

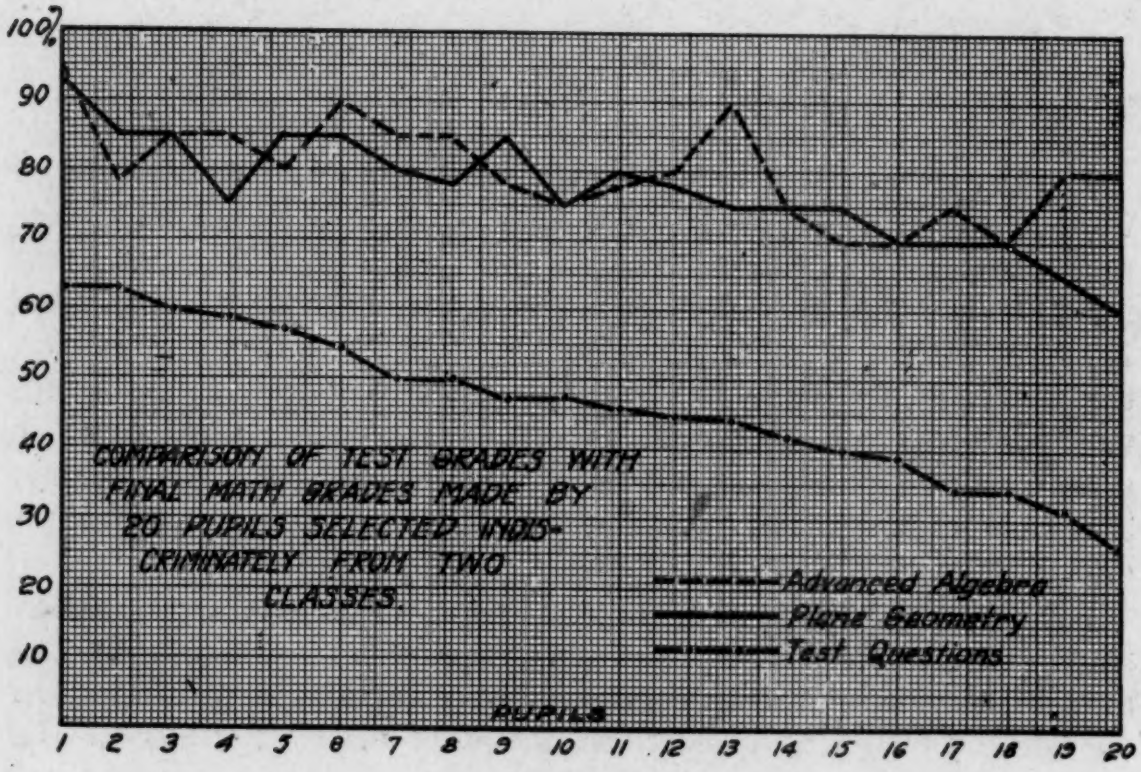


FIGURE VI

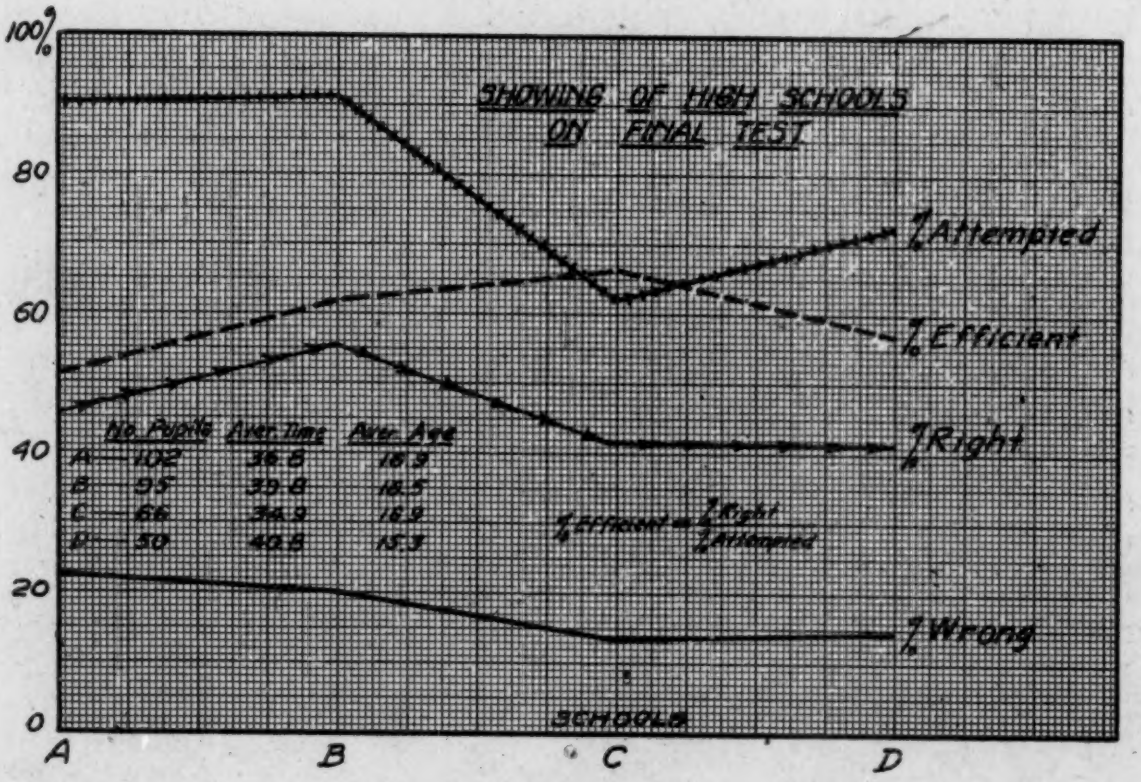


FIGURE VII

A SURVEY OF SPEECH DEFECTS

SMILEY BLANTON, M. D.
University of Wisconsin

During recent years, there has been an increasing interest in the problem of speech defects in school children. The newly organized speech clinic of New York City, the speech improvement work in the schools of Wisconsin and other states, the notable survey of 89,057 children in the St. Louis schools under the direction of Dr. J. E. Wallace Wallin, show how seriously this matter of speech defects is being considered. With the hope of adding some new light to this subject, a personal survey was undertaken by myself, assisted by Erminie Ballard and Margaret Gray Blanton, of all the children below the high school grade in the public and parochial schools of Madison, Wisconsin.[1] Madison has a population of about 30,000, and may be considered a typical American city of the middle West, so the figures gathered will probably hold true of other cities. The aim of the survey was to make a careful first hand study of the speech defects found in the schools, and to compare the results with those gained by the questionnaire.

Method of Procedure

A blank was used, whereon was recorded the name, age, and grade of each child with a speech defect. By comparing the age of the child with the grade, it was possible to tell if the child was retarded. The speech defects were classified under three heads: Stuttering, lisping and miscellaneous; a further sub-division under each head of mild, medium, and severe, was used. It is not possible to make distinction between mild, medium, and severe with scientific accuracy; the distinction was a rough one and depended largely upon the experience of the observer.

Stuttering, which includes stammering, was used to designate a speech defect that can be defined as a psycho-neurosis, of which the most obvious signs are continuous or interrupted spasms of the organs of respiration, phonation, or articulation. The mind is usually dominated during the symptoms by the emotion of fear. Ordinary hesitations and repititions in reading, choreic

[1] I wish to thank Supt. Dudgeon and Father Conway, through whose kind cooperation the survey of the Madison public schools and the parochial schools was made possible. Thanks are also due to Dr. J. A. Bancroft, who made the impressions for the cuts used in this article.

movements, tics of the face during speaking, were not included under this head. Under the heading lisping were placed all those cases that definitely gave the wrong sound for the consonants s, z, t, and th. Age and dentition were taken into consideration. Under miscellaneous were included five groups: thick speech, indistinct speech, aphasia, mutism, and nasality. Thick speech is the type of defect found in children who have poorly developed tongues caused often by rickets or lack of thyroid extract, resulting in cretanism, or those who have a defective nervous system and are unable to make the fine coordinations necessary for correct speech. The "feeble-minded" have chiefly this kind of speech defect. Indistinct speech occurs in those who continue to use the slurring, indistinct speech of babyhood after they have reached school age. Examples will be given presently. Only cases of motor aphasia were considered. Motor aphasia in this case may be defined as the inability to use spoken language when there is no injury or destruction of peripheral nerves that govern the speech mechanism. By mutism is meant a defect in which the child, due to inhibitions or mental conflicts, refuses to, or is unable to, speak in school or with strangers, but is able to talk normally with certain persons, usually members of his own family. All cases grouped under nasality had cleft palates, either the hard or soft palate, or both. No case of any type of defect was included unless it was so marked that it could be recognized even by the casual observer. Slight slurs on the s and z sounds, ordinary nasal voice, or cases of slovenly speech were not considered. The cases of defects discovered in the classroom were referred to the teacher, and unless she agreed that the condition was severe enough to be called a speech defect, they were not included.

From kindergarten to fourth grade, the test used was some Mother Goose rhyme. After it had been ascertained that the children were familiar with the rhyme, each was asked to repeat it, saying it as well as he could. From the fourth through the eighth grade, this sentence was used: "The quick, red fox jumped over the simple, lazy dog." This was repeated several times until all the children with normal intelligence had memorized it. After a speech defect was discovered in this way, further tests were given to more clearly distinguish it. Those who seemed to have a lisp were asked to say the Mother Goose rhyme "Simple Simon met a pie-man" or "Simple Simon sold silks." For thick

and indistinct speech, various words and combinations of letters were given. Tests were given to determine aphasia, and some of those appearing very dull were given the Binet-Simon and the Knox-Healy mental tests. The speech of each child suspected of stuttering was further tested by reading and conversation. Finally, the mouth of each child was examined for the shape and formation of the hard and soft palate, for the shape of the jaw, and the occlusion of the teeth.

Results Obtained

Seventeen schools were visited, twelve public and five parochial, and the number of pupils examined was four thousand eight hundred and sixty-two, ranging in age from four to eighteen years. Twenty-four of these were in special classes, but the children were recorded as being in the grade corresponding to the grade of work they were doing.

TABLE I.

	Stutterers	Lispers	Miscellaneous					
			Indist.	Thick	Nasal	Mutism	Aphasia	
Female.....	8	69	19	1	2	0	2	101
Male.....	27	90	49	5	3	2	0	176
Totals.....	35	159	68	6	5	2	2	277

From Table I can be seen the total number of speech defects, the number of each type of defect, and the distribution among the males and females. The percentages are as follows:

Total number of speech defects	5.69
Stutterers	.72
Lispers	3.27
Miscellaneous	1.71

The percentage of total number of speech defects is about twice as large as the 2.46% found by Conradi in 1904 in a survey of 87,440 children in Kansas City, Milwaukee, Cleveland, Louisville, Albany, and Springfield, Mass.,[2] and as the 2.8% found by Wallin in a survey made in October, 1915, of 89,057 children in the St. Louis schools.[3] The percentage of stutterers, .72, is practically the same as that found by Wallin, .7, but the percentage of lispers and miscellaneous defects is about three times as large. Wallin's percentages are lispers, 1.6, miscellaneous, .4. This difference is due, I think, to the fact that the figures were gathered in the St. Louis survey by means of the questionnaire,

[2] Conradi. *Speech Development in the Child.* Ped. Sem. Vol. 11, p. 365.
[3] Wallin. *A Census of Speech Defects.* School & Society, Feb. 5, 1916.

and many of the cases of thick and indistinct speech and cases of lisp ng were not reported by the class teacher, not accustomed to classifying speech defects. It should be remembered that in the present survey in order to avoid the criticism that cases were called speech defects that were merely cases of poor enunciation, no case was recorded unless the class teacher agreed that the child in question had a definite speech defect.

Table I shows the usual relationship of three males to one female stutterer. It also shows a decidedly smaller number of cases of lisping and miscellaneous speech defects among the females than among the males.

Table II shows the great number of deformities of jaw and teeth found, a total number of protruding and retracted jaws of 99, or 35.7%. Some of the jaw conditions are illustrated by the cuts shown on another page. There were many more cases of enlarged adenoids and tonsils than were reported, but as a thorough physical examination of the throat and nose could not be made and the records of the examining physician could not be easily obtained, only six cases were recorded. The large number, 49 or 17.7%, of retarded children found among those with speech defects is significant. The cases were called retarded that were two or more years behind their grade, without adequate explanation. About ten of these were feeble-minded children whose

TABLE II.

	Sum Total	Male	Female	Mild	Medium	Severe	P. L. J.	R. L. J.	Tonsils and Adenoids	Retarded
I	26	15	11	5	13	8	12	3	1	4
II	15	10	5	9	5	1	1	3	0	3
III	18	11	7	10	7	1	0	3	0	2
IV	12	4	8	5	5	2	0	1	1	0
V	5	3	2	1	2	2	0	0	0	0
VI	12	9	3	3	6	2	0	0	0	0
VII	24	18	6	9	13	2	2	0	1	4
VIII	14	12	2	3	7	4	7	0	0	2
IX	36	21	15	15	12	9	15	11	2	8
X	30	17	13	16	7	7	10	4	0	8
XI	18	11	7	10	4	4	3	6	0	0
XII	35	28	7	18	8	9	7	4	0	12
XIII	4	1	3	0	4	0	0	0	1	1
XIV	15	10	5	1	8	6	1	2	0	1
XV	6	3	3	1	4	1	0	0	0	1
XVI	7	3	4	1	6	0	1	1	0	3
Totals	277	176	101	107	111	59	61	38	6	49

speech defect was due to the lack of brain development. We felt, however, that a great majority were retarded *because of the speech defect*, and in a number of these cases, the class teacher declared that it was the sole cause of the backwardness. There can be no doubt that speech defects, especially stuttering, cause backwardness in the school work of otherwise normal children.

Table III shows the different types and the total number of speech defects in each grade. It is seen that the number of defects is greatest in the first grade and gradually diminishes until, when the eighth grade is reached, they have practically disappeared. The curve shows this graphically. A great many children get over their speech defects, that is, they are able to speak without a noticeable defect, but there remains, in practically every case of lisping and thick and indistinct speech, a poor articulation, a slovenly condition of the speech that is so common. Many children are so retarded in their school work by their speech defect that they drop out as soon as they reach the age when the law allows them to stop school, and many children who acquire a speech defect at pubescence get discouraged and drop out. Most of these cases drop out about the fifth grade. In the case of the stutterers, even though the symptom be recovered from, there remains in many cases the original mental conflict, the lack of adjustment that causes other neurotic symptoms beside stuttering.

The most significant points on the chart are the kindergarten, 6.4 per cent., first grade, 11.05 per cent., and the seventh grade, 4.51 per cent. Experience shows that the children in the kindergarten who have speech defects acquired them at the beginning of speech development. The increased percentage in the first grade may be attributed to four causes:

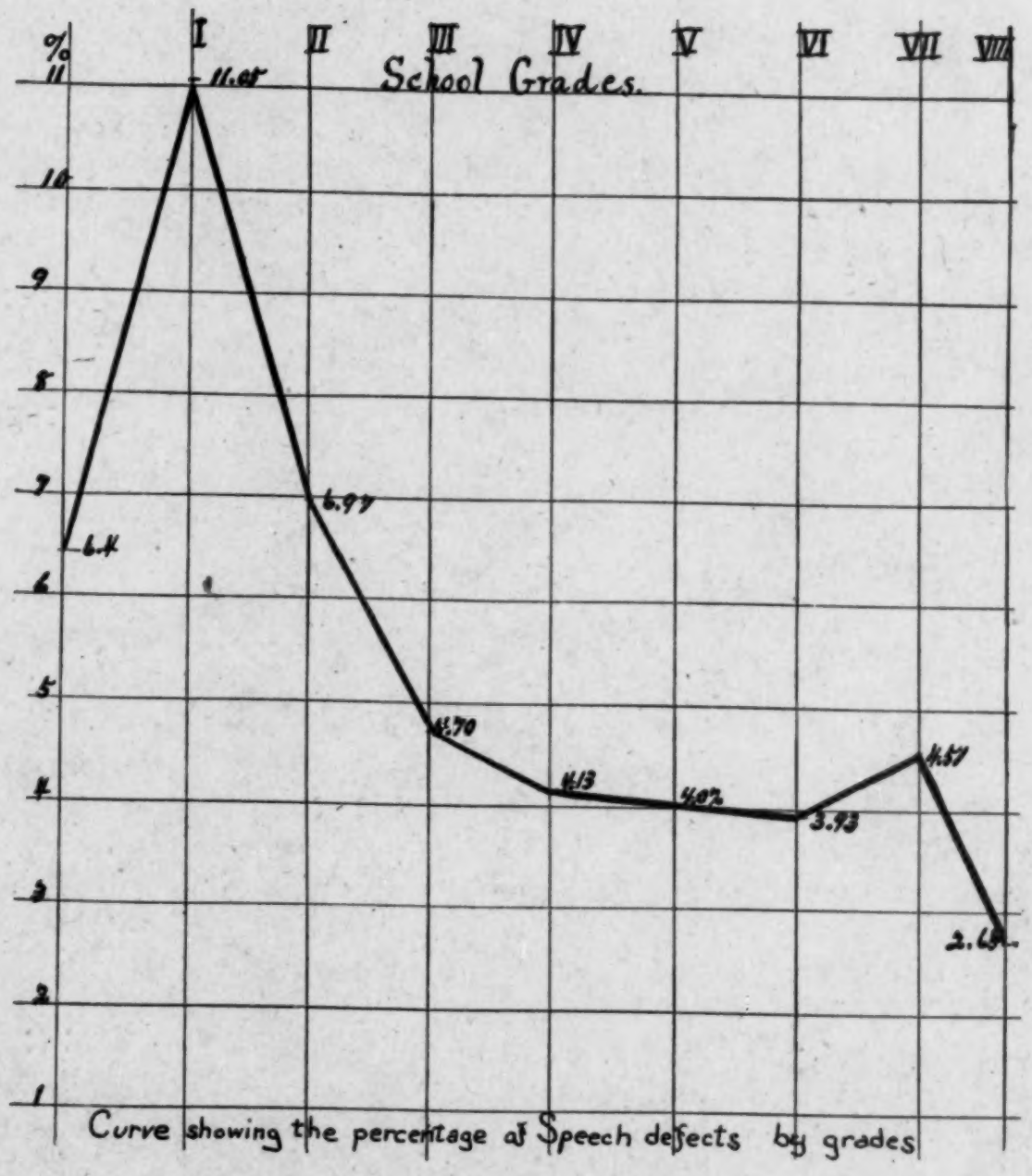
1. The beginning of formal study.
2. The breaking of home associations.
3. The change in dentition.
4. The study of reading.

In the beginning of formal study, the nervous child is made more nervous, the sufferer from malnutrition and the sickly child are put on a still further strain, all of which is likely to cause or aggravate cases of stuttering or neurotic lisping. The breaking of home association may cause mental conflicts that affect the speech mechanism The change in dentition: in order to make the proper sound of s and z, the teeth must be closed, and when

TABLE III

Speech Defects. First 8 Grades and Kindergarten

By Grades		Stutterers				Lisping				Indistinct				Thick				Nasal				Mutism				Aphasia				Percentages	Totals
		Mi.	Me.	Se.	Total	Mi.	Me.	Se.	Total	Mi.	Me.	Se.	Total	Mi.	Me.	Se.	Total	Mi.	Me.	Se.	Total	Mi.	Me.	Se.	Total	Mi.	Me.	Se.	Total		
K	M.....	0	0	1	1	1	5	0	6	5	2	2	9									0	0	1	1						17
	F.....	0	0	0	0	3	2	0	5	1	0	3	4									0	0	0	0						9
	Total...	0	0	1	1	4	7	0	11	6	2	5	13									0	0	1	1					6.4	26
I	M.....	2	0	0	2	7	12	5	24	5	5	6	16	0	1	0	1	0	0	1	1	0	0	1	1						45
	F.....	0	0	0	0	10	10	2	22	2	4	3	9	0	1	0	1	0	0	0	0	0	0	0	0						32
	Total...	2	0	0	2	17	22	7	46	7	9	9	25	0	2	0	2	0	0	1	1	0	0	1	1					11.05	80
II	M.....	2	1	1	4	6	8	4	18	2	5	2	9	1	0	0	1														32
	F.....	0	0	0	0	4	3	4	11	0	2	0	2	0	0	0	0														13
	Total...	2	1	1	4	10	11	8	29	2	7	2	11	1	0	0	1													6.97	45
III	M.....	1	0	0	1	3	8	2	13	0	1	0	1	0	1	0	1	0	1	0	1										17
	F.....	1	0	0	1	5	3	0	8	0	1	1	2	0	0	0	0	0	0	1	1										12
	Total...	2	0	0	2	8	11	2	21	0	2	1	3	0	1	0	1	0	1	1	2									4.70	29
IV	M.....	2	1	0	3	5	7	0	12	2	1	0	3	1	0	0	1														19
	F.....	1	0	0	1	3	2	0	5	0	0	0	0	0	0	0	0														6
	Total...	3	1	0	4	8	9	0	17	2	1	0	3	1	0	0	1													4.13	25
V	M.....	3	2	0	5	0	3	2	5	1	2	2	5	0	1	0	1														16
	F.....	2	0	0	2	1	2	0	3	0	1	0	1	0	0	0	0														6
	Total...	5	2	0	7	1	5	2	8	1	3	2	6	0	1	0	1													4.02	22
VI	M.....	4	0	1	5	3	1	2	6	0	2	0	2																		13
	F.....	1	0	0	1	2	3	1	6	0	0	0	0																		7
	Total...	5	0	1	6	5	4	3	12	0	2	0	2																	3.93	20
VII	M.....	0	0	3	3	2	1	1	4	0	3	0	3					0	0	0	0										10
	F.....	0	1	1	2	3	1	1	5	0	1	0	1					0	0	1	1										9
	Total...	0	1	4	5	5	2	2	9	0	4	0	4					0	0	1	1									4.51	19
VIII	M.....	1	1	0	2	1	0	0	1	1	0	0	1					0	0	1	1										5
	F.....	1	0	0	1	3	0	0	3	0	0	0	0					0	0	0	0										4
	Total...	2	1	0	3	4	0	0	4	1	0	0	1					0	0	1	1									2.65	9
Male.....					27				90				49				5				3				2			0			176
Female.....					8				69				19				1				2				0			2			101
Total.....					35				159				68				6				5				2			2			277



Curve showing the percentage of Speech defects by grades

the front teeth are absent, there is a slurring of these sounds. The speech habits formed at this time are in some cases carried over into later years. In this survey, no child was counted as having a speech defect who lisped because of absence of the front teeth. In reading, different phrasing and breathing are necessary for the potential stutterer. The increased percentage of defects in the seventh grade is due to the influence of puberty, instability of the nervous system, and mental conflicts. The sharp decline between the seventh and eighth grades is caused by the dropping out of school, by a relatively great per cent. of unfit children. As has been mentioned, many of the cases drop out before the seventh grade. But if all the cases of speech defects in the first grade remained in school until the seventh grade, the percentage would be astonishingly higher in this grade.

The thirty-five cases of stuttering ranged in severity all the way from a slight hesitation to a condition where there were severe spasms of the face and body, as well as the muscles of the speech mechanism. Some interesting facts were discovered by a thorough study of fifteen of these stuttering cases.

1. In one-third of the fifteen cases studied heredity played a part in the etiology, as it was found in five cases that one of the parents stuttered or had stuttered.

2. Another third of these cases seemed to be developed by some specific shock, which gave rise to some mental condition. H. S. is a good illustration. He is a Russian Jew thirteen years and two months old. At the age of nine years, he was struck and abused by a boy some years older than himself. He seemed to become troubled and less cheerful after this, and shortly he began to stutter. He is a severe stutterer, and has an unusual tic when talking that takes the form of a rhythmic swaying of his body backward and forward when he tries to talk. The association test and psycho-analyses are being used to determine the mental conflict that causes his symptoms.

3. The third five were caused by some mental conflict arising in relation to the child's home or school conditions. T. M. is an Italian boy of nine years, and illustrates how conflicts causing speech defects arise in relationship of the child to his school. He spoke only Italian when he started to school, and when he tried to speak English, he began to stutter. There are other elements in this case, but the language conflict seems to be the chief etiological cause.

The average age at which stuttering began was six years. At least ten of the cases studied are decided neurotics, and unless given treatment, will become chronic neurotics and social failures. It is this fact that should be emphasized, that the stuttering child is suffering from a neurosis, and in most cases, unless treatment is given, he will become a social failure.

Lisping is the most frequent of all the speech defects. It may be divided into three types; simple, neurotic, and organic. Simple lisping arises because of carelessness, or during the period between the loss of the first teeth and the eruption of the permanent teeth. Phonetic drills are sufficient to cure the simple lisp.

In the neurotic lisp, there exists such a nervous condition that the child is unable to use the speech mechanism properly, and the tongue is not placed in the right position for making the s sound. Good hygiene, as well as phonetic drills, is needed here in order to eliminate the defect. In the case of organic lisping, there is some abnormality of the teeth or jaws or palate. If there is a marked protrusion of the lower jaw, so that the lower teeth come in front of the upper when the jaws are closed, lisping or imperfect speech is sure to result. And the same is likely to occur if the upper teeth protrude too far in front of the lower. These deformities are often caused by thumb sucking and the use of the pacifier. The following six pictures illustrate the different types of deformities found in lisping children. Such children require the care of the oral surgeon before they can speak correctly.

The case of S. M. illustrates a type of indistinct speech. S. is 7 years, 4 months of age. When she entered kindergarten at the age of five, she made only inarticulated sounds. She had poor ability in hand work, and was awkward in her movements, often falling down when attempting to run and skip with the other children. She is now in the first grade, but will not pass this year. For the past three months, she has been given work in corrective phonetics. When we began this training, her speech was absolutely unintelligible, but it had improved 100% by June. Even yet, her speech is quite imperfect. When asked to say Mother Goose rhyme:

"Jack and Jill
Went up the hill
To fetch a pail of water;
Jack fell down
And broke his crown,
And Jill came tumbling after."

Picture No. 1

Medium Lisp Age: 12 yrs. 2 mos. Fifth Grade

This case had enlarged adenoids and tonsils and as a result has a high, narrow arch. The upper jaw is pointed and protruding. Because of the high narrow arch of the hard palate and the retracted lower jaw, the child has difficulty in raising the tongue to the roof of his mouth, so as to take the correct position in making the sound s.

Picture No. 2

This is the arch of the hard palate of the impression shown in picture No. 1.

Picture No. 3.

Medium Lisp Age: 13 yrs. 2 mos. Fourth Grade

This child is backward, repeated first and second grades.

She was late in learning to talk, and at the age of seven could not speak distinctly. Beside a slight retraction of the lower jaw, there is a backward tilt of the lower teeth. The lisp occurs almost exclusively on the s sounds.

Picture No. 4

Severe Lisp Age: 13 yrs. Fifth Grade

In this boy, there is such an irregularity of the teeth that they do not meet, and hence the sound of s cannot be properly made.

Picture No. 5

Mild Lisp Age: 6 yrs., 11 mos. First Grade

In this case, the occlusion of the teeth is about normal, but the teeth are very irregular. Th is substituted for the s sound.

Picture Nb. 6

Medium Lisp Age: 9 yrs. 2 mos. Fourth Grade

This little girl was without front teeth for about six months and at this time the lisping began. There is a protrusion of the lower jaw, and the upper teeth are large and uneven. The lisp is chiefly on the s sound.

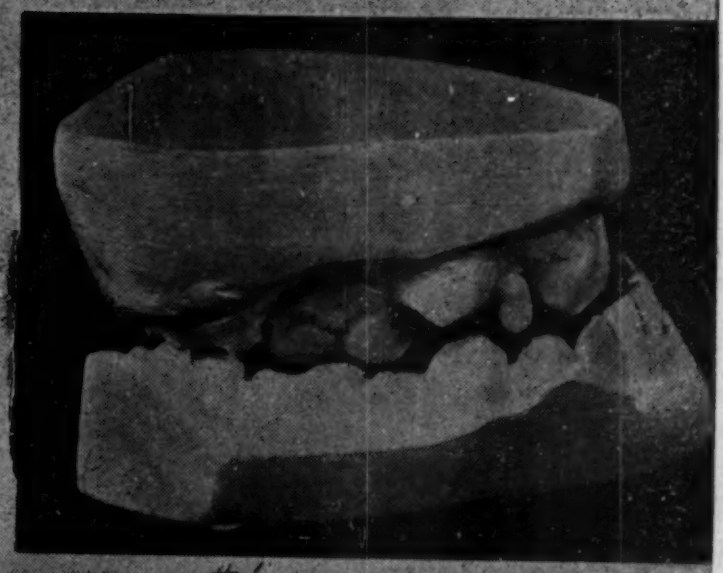
#1

#4

#2

#5

#3



#6

she said it this way:

"Da er De
Weh er o Hill
To feh er pa er wotty;
Da feh dow
And boke he pow
De ta tuddy atte."

From an analysis of this phonetic representation of the speech of S., we can see that she did not make the j sound, nor the p, t, ch, n, r, and f sounds. Without speech training, this child would probably become more and more retarded and possibly never get out of the high grade moron class. In this, as in other cases, the speech defect was only a symptom of a wide-spread condition. There was lack of motor co-ordination in the hands and legs, becoming more marked in the fine muscles of the speech mechanism. Speech training in such cases is not only needful to improve the speech, but it stimulates the growth of the brain cells in quite a direct way. Of course, general motor education was given, as well, for its effect on the speech mechanism.

The conclusions to be drawn from this study of children with defects of speech are, we believe:

1. There are five per cent. of school children, more than are given in most surveys, suffering from speech defects.

2. Speech defects relate themselves to the problem of the feeble-minded and retarded children, and also to those who have some neurotic trait that disqualifies them from adjusting themselves to the school routine.

3. There should be special teachers appointed to treat the children with speech defects. Courses in speech training should be given in the kindergarten and first and second grade, where most of the speech defects begin, and by such a training, mild cases of speech defects could be cured, and many defects could be prevented altogether. The special teachers should have more than a training in phonetics or public speaking or elocution. They should know the anatomy and physiology of the speech mechanism, and know something of abnormal psychology and the principles of psycho-analysis. Teachers so trained are needed in a majority of the school systems of this country.

METHODS OF EXPRESSING RESULTS OF MEASUREMENTS OF INTELLIGENCE: COEFFICIENT OF INTELLIGENCE[1]

ROBERT M. YERKES AND LOUISE WOOD

Ordinarily, it is not very difficult to devise means of expressing the results of simple mental, social, or physical measurements. But it appears that the sort of measurements which result from the application of scales for measuring intelligence are not readily expressible in strictly comparable terms. For several years, group measurements of intelligence have been made by the Binet and other scales, and various means have been employed for expressing the general results. But the modes of expression have varied extremely in convenience, reliability, and comparability. It is evident that at present there is no generally understood and commonly accepted statistical datum for such measurements.

Of the several modes of expressing intellectual status, the following are most commonly used: (a) mental age; (b) age-difference (retardation or acceleration); (c) frequency, or order of rank; (d) deviation from the median, mean, or normal value; (e) intelligence quotient (sometimes improperly designated as mental quotient); (f) coefficient of intelligence.

As a preliminary to our consideration of certain data concerning the coefficient of intelligence, we shall review the important characteristics of these six modes of statement.

(*a*) *Mental Age.* From the practical point of view, this seems the simplest and most natural way of expressing intellectual status, but its apparent simplicity is misleading and its practical value tends to be overestimated. For, in the first place, although it is commonly assumed that the statement "mental age of ten years" (more strictly, intellectual age) has very definite meaning for most of us, inquiry indicates that it does not, and further that even reasonably experienced psychologists, psychological examiners, teachers, and parents have widely varying conceptions of the intellectual ability of the average ten-year-old boy or girl. Again, mental or intellectual age gains significance only through comparison with another age value for the individual. Most commonly used for this comparison is the so-called chronological age, or period since birth. Inasmuch, however, as rate of growth and time of maturing vary considerably in individuals, it is clear that chronological age is not a safe basis for prediction of intellectual status. Instead, what may appropriately be termed physiological age should be used. This, like the intellectual age, must be determined by carefully selected measurements.

It is then clear that mental age alone lacks practical value, that it gains value when viewed in relation to physiological age. It is therefore necessary to employ

[1] Being Contribution of the Mass. Commission on Mental Diseases, whole number 155, 1916. 13. The previous contribution (154, 1916. 12) was by E. E. SOUTHARD, entitled "*The Psychopathic Hospital's Function of Early Intensive Service for Persons not Legally Insane*," to appear in Proceedings of the National Conference of Charities and Correction, 1916.

either instead of, or in addition to, the value mental age an expression of the relation of mental age to physiological age. This has been done in many cases by determining the difference between the two ages. The statistical datum thus obtained may well be termed age-difference. Actually, age-difference has not been used alone in descriptions of intelligence measurements, but since it evidently might be, we shall consider it below as mode (b) of expressing results of measurements of intelligence.

(*b*) *Age-difference.* As has already been stated, the difference between mental age and chronological age is misleading because of individual variations in growth. But even when physiological age is used instead of chronological age, a serious objection to age-difference as an index of intelligence may be offered. For the value of a given period, say a year, of mental development varies with age. The amount of intellectual development occurring in one year during early childhood is equal to that which occurs in two years during late childhood or during four or five years during adolescence. Otherwise expressed, since the significance of the chronological unit of development varies, that unit cannot be used alone as a means of expressing intellectual status.

(*c*) *Frequency Order of Rank.* It is obviously serviceable to know the relative value or rank-order of a given individual's intellect. Such a value might be known as intelligence frequency, relative intelligence, or simply rank. It has the advantage of indicating what may reasonably be expected of an individual in comparison with his fellows. One way to express frequency is in terms of the percentage of occurrence of a given order of intellect. Miner[2] has recently advocated the use of this device as a means of defining intellectual deficiency. Examiners would necessarily make use of statistical tables or curves of the distribution of intelligence in evaluating individual measurements.

Frequency of occurrence is unquestionably a useful datum, which should be presented, if not instead of, then in addition to, certain other statistical indices which possess greater scientific value.

(*d*) *Deviation.* It is possible, and it may ultimately prove highly desirable, to employ some form of deviation-value as a measure of intellectual status. Either the average or the standard deviation may be thus used. But it remains to be seen whether such values are in any respects superior to the ratios which are discussed below.

(*e*) *Intelligence Quotient.* The intelligence quotient, although less widely employed by psychological examiners than mental age or age-difference, has very important advantages. These have been appreciated by those investigators who considered seriously the statistical aspects of description. Prominent among the advocates of this mode of expression are Stern,[3] Bobertag,[4] Kuhlmann,[5] and Terman.[6] The intelligence quotient is the ratio of mental age to chronological age. It has been used repeatedly in connection with Binet measurements, and it should be understood that its value varies extremely with the form of the Binet method which happens to be employed. This accounts for certain adverse criticisms of the mode of expression.[7]

From what has been said, it is apparent that the intelligence quotient is the natural way of avoiding important defects of mental age and age-difference. The reliability of the quotient depends upon several variable factors, important among which are the accuracy of the measurements of intelligence and the trustworthiness of chronological age.

---

[2] Miner, J. B. *A Percentage Definition of Intellectual Deficiency.* The Psychological Bulletin, 1916, **13**, 89.

[3] Stern, William. *The Psychological Methods of Testing Intelligence* (English translation). Baltimore, 1914, 36–42.

[4] Bobertag, O. *Ueber Intelligenzprüfungen.* Zeitschrift für angewandte Psychologie, 1912, **6**, 531.

[5] Kuhlmann, F. Journal of Psycho-Asthenics, 1913, **17**, 132.

[6] Terman, L. *The measurement of intelligence.* Boston, 1916, 65.

[7] Doll, E. A. *Note on the intelligence quotient.* The Training School Bulletin, 1916, **13**.

Stern claims that the value of the intelligence quotient tends to diminish with age. Terman maintains, in the light of data yielded by the Stanford revision of the Binet method, that it is practically constant.

It is our impression that for the expression of Binet results nothing comparable in statistical value to the intelligence quotient has been suggested, but it should be added that the reliability of the quotient will necessarily vary with the method of measurement. The Stanford Revision of the Binet scale promises to yield more accurate measurements of intellectual status, and consequently more reliable intelligence quotients than does the original or any other modification of the Binet scale.

(*f*) *Coefficient of Intelligence.* The same in principle as the intelligence quotient of the Binet method is the coefficient of intelligence of the point-scale method. This value has been termed coefficient instead of quotient because it is not directly comparable with the Binet quotient. Were we to speak of it as an intelligence quotient, confusion would result, and from overhasty or thoughtless critics would come ill-founded objections.

The coefficient of intelligence is definable as the ratio of an individual's point-scale score to the expected score, or norm. As in the case of the intelligence quotient, the coefficient may be expressed as a fraction. Thus for I. Q. we have $\frac{7}{10}$ to indicate that a child of seven-year intelligence is chronologically ten years old, or in decimal form, the I. Q. reads .70. For the point scale, the fraction $\frac{20}{35}$ means that a child for whose age the expected score is 35 points obtains in examination only 20 points, or expressed as a decimal, the coefficient of intelligence for the individual is .57.

What has already been said of the importance of physiological age in connection with measurements of intelligence applies with equal force to the point-scale procedure. For it is clearly unfair to expect of an individual who is physically retarded because of malnutrition or overwork the mental age appropriate to his chronological age. We are in agreement with Crampton,[8] who has presentedsand defended the the is "physiological age should be taken a a basis for all records, investigation, pedagogical, social, or other treatment of children." And although we have not yet been able to present physiological age norms for use in connection with the point scale, we are fully convinced of their desirability and heartily welcome all efforts directed toward the development of serviceable methods of measuring physiological age.[9]

[8] CRAMPTON, C. WARD. *Anatomical or Physiological Age versus Chronological Age.* The Pedagogical Seminary, 1908, **15**, 230.

[9] BALDWIN, BIRD T. *A Measuring Scale for Physical Growth and Physiological Age.* The Fifteenth Year Book, Part I, National Society for the Study of Education, 1916, 11–22.

In the present stage of development of measurements of intelligence and of modes of dealing with them, it is highly desirable to determine, so far as possible, the practical and scientific value of the coefficient or quotient of intelligence. Kuhlmann, some years ago, clearly perceived the desirability of expressing degree of deficiency "by some mathematical relation of the mental and chronological ages." He has since argued most effectively for the use of the intelligence quotient in connection with Binet measurements. He further appreciated the importance of rate of mental development and the desirability of definite measurements thereof, but at that time he wrote, "We have at present no means of measuring this rate of progress and its changes."[10] The measurements of which Kuhlmann felt the need, the point-scale method supplies. Indeed, at the time the above sentence was written by him, we were engaged, in the Psychopathic Hospital, Boston, in developing the point-scale method as a means of measuring the rate of intellectual growth and of determining individual intellectual status.

For the safe use of intelligence coefficients or quotients, it is essential to look well to the following fundamentals of method and information. (1) Reliable norms of judgment. For the point-scale method these should be physiological age-norms, by half years or smaller intervals. The Binet method also rests upon norms, but they are embodied in the structure of the scale and are usually spoken of as the standardization or age arrangement of tests. (2) Normal distribution or frequency of measurements and of resulting coefficients or quotients. Highly reliable distribution tables and curves must be made available if our measurements of intelligence in childhood or maturity are to be reliably expressed in terms which shall render comparison both convenient and safe. (3) Correction for physiological age where chronological or other age data are regularly employed.

We have been able to accumulate, during the past three years, upward of four thousand point-scale examinations. The data of these examinations bear so directly upon the important points which have been made with reference to modes of expressing intellectual status that we wish to present, briefly, the significant results for certain of our groups of measurements.

The total number of subjects for whom coefficients are presented below is twenty-four hundred and fourteen. These fall into the following six groups:

[10] Journal of Psycho-Asthenics, 1913, **17**, 136.

Pupils of Cambridge schools	829
Pupils of Iowa schools	166
Cincinnati 18-year old group	237
Massachusetts adult group	50
Ohio Industrial School group	997
Little Wanderer's Home group	135
	2414

Of these examinations, twelve hundred and eighty-two constituted what we shall call the normal group; eleven hundred and thirty-two, the Ohio Industrial School group and the Little Wanderer's Home group, constitute a specially selected group which cannot be designated as normal.[11]

The coefficients were determined by use of the intellectual norms offered in "*A Point Scale for Measuring Mental Ability*," page 66. For age 16—the norm 84 and for age 17—the norm 86 were used. For all except twenty-five of the individuals eighteen years of age or above, the norm 88 was used; for the excepted group, a special norm of 94. Since for some of the subjects whose examinations were reported to us, we knew the age only to the nearest year, all coefficients were calculated without reference to fractions of a year. This introduces a very large error for young children and one which is practically negligible for adults. We regret exceedingly that our coefficients could not have been determined on the basis of year and month age data for all subjects.

For the group of two hundred and thirty-seven eighteen-year-old children, the age-differences and the coefficients of intelligence are offered in Table I, and as another sample of these values, there appear in Table II the results for the group of one hundred and thirty-five individuals examined at the Little Wanderer's Home.

The distribution of coefficients for the twelve hundred and eighty-two subjects included in the public school groups, the eighteen-year-old group, and the Massachusetts adult group, appears in Table III. The most important facts of this distribution are, first, the diminishing range of coefficients with increasing age; and second, the relative uniformity of range for the years eight to thirteen. This table, in conjunction with our experience

[11] We wish to express our indebtedness and heartiest thanks to Professor R. H. Sylvester of the University of Iowa, to Doctor Helen Thompson Woolley of Cincinnati, to Doctor T. H. Haines of Columbus, and to Miss Rose S. Hardwick of the Little Wanderer's Home, Boston, for data from their respective localities or institutions.

TABLE I.

Age Differences and Coefficients of Intelligence for 18-year Group (237). Norm used 88. Average Score for Group 89+ (Woolley)

Males						Females					
No. of Cases	± Yrs.	Coef.	No. of Cases	± Yrs.	Coef.	No. of Cases	± Yrs.	Coef.	No. of Cases	± Yrs.	Coef.
2	—8.8	.65	7	—5.0	.90	1	—9.9	.48	3	—6.0	.87
4	—8.3	.68	5	—4.5	.91	1	—9.7	.51	3	—5.5	.89
2	—8.2	.69	10	—4.0	.92	2	—9.0	.64	3	—5.0	.90
1	—7.7	.72	7	—3.3	.93	2	—8.6	.66	6	—4.5	.91
2	—7.5	.73	4	—2.7	.94	1	—8.3	.68	3	—4.0	.92
2	—7.0	.74	5	—2.2	.95	1	—8.2	.69	6	—3.3	.93
4	—6.9	.75	8	—1.5	.97	1	—8.0	.70	6	—2.7	.94
1	—6.7	.77	5	—1.0	.98	3	—7.7	.72	3	—2.2	.95
3	—6.6	.78	1	— .5	.99	2	—7.5	.73	3	—1.5	.97
3	—6.5	.80	6	0	1.00	1	—7.0	.74	5	—1.0	.98
2	—6.5	.81	1	.....	1.01	1	—6.9	.75	2	— .5	.99
2	—6.4	.82	2	.....	1.02	3	—6.8	.76	6	0	1.00
4	—6.3	.83	1	.....	1.03	1	—6.7	.77	4	.....	1.01
6	—6.2	.84	3	.....	1.05	3	—6.6	.78	2	.....	1.02
7	—6.1	.85	3	.....	1.08	1	—6.5	.80	2	.....	1.03
2	—6.1	.86	1	.....	1.09	1	—6.5	.81	1	.....	1.06
4	—6.0	.87	1	.....	1.10	1	—6.4	.82	4	.....	1.07
7	—5.5	.89				3	—6.3	.83	4	.....	1.08
						3	—6.2	.84	2	.....	1.10
						5	—6.1	.85	1	.....	1.12
						3	—6.1	.86			

in using the point scale, convinces us that the original or preadolescent point scale, whose data alone are used in this paper, is not satisfactory for young children. It possesses maximal value for the ages seven or eight to twelve or thirteen; it is markedly unsatisfactory for the ages four and five; reasonably reliable for the ages six and seven, and above thirteen.

Terman has stated as an argument in favor of the intelligence quotient, that for his examinations the range of the quotients is practically constant from four years to fifteen years. We should not have predicted this constancy of range any more than we should have predicted for the coefficient of intelligence a marked decrease in range with increasing age. Evidently, however, the reliability of our coefficient and its value for purposes of comparison are conditioned by characteristics of range. It should be noted that precocity has much greater influence early than late in intellectual development. Indeed, our own data show that a few months' difference in age will alter the coefficient of a five or six year old child by ten to thirty per cent.; of the adult, by five to ten per cent. Table 3 makes it appear that extraordinary intellectual ability is fairly common up to eight years of age, and then becomes very uncommon.

TABLE II.

Age-Differences and Coefficients of Intelligence for Little Wanderers Home Group of 135 Children (Hardwick)

4 Years		5 Years		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years		12 Years		13 Years		14 Years		15 Years		16 Years		17 Years		18 Years		19 Years	
± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.	± Yrs.	Coef.
−2.0	.53	−4.0	.14	−4.9	.29	−4.1	.38	− .8	.83	−2.9	.54	−2.3	.63	−9.2	.11	−8.8	.39	−6.9	.38	−5.3	.70	−4.2	.82	−6.7	.68	−7.5	.67	−9.0	.62	−6.5	.80
−2.1	.55	−3.0	.44	−3.3	.39	−1.5	.73	− .2	.91	− .8	.67	−1.7	.69	−3.2	.61	−2.2	.79	−3.5	.78	−2.6	.87	−3.3	.85	−4.4	.73	+ .3	1.01	−7.1	.72	−6.4	.81
		−2.6	.45	−3.3	.44	−1.6	.73	− .1	.96	−1.4	.69	−1.3	.82	−2.1	.85	−3.0	.79	−3.6	.78	−2.3	.90	−3.1	.90	−4.9	.79	+ .7	1.03	−7.0	.75	−4.0	.92
		−1.9	.57	−2.8	.46	−1.3	.76	− .1	.98	−1.3	.77	−1.3	.89	−1.6	.88	− .9	.89	−2.0	.82	−2.1	.90	−1.6	.99	−3.1	.93			−6.7	.78	0	1.70
		−1.2	.71	−2.6	.51	−1.1	.81	+ .9	1.33	− .8	.81	− .5	.95	−1.5	.91	0	.99	−2.2	.83	−2.0	.95	+ .7	1.05	+1.2	1.02			−4.5	.90		
		−1.0	.77	−2.5	.53	− .6	.89			− .8	.81	− .5	.97	− .2	.96	+1.8	1.05	−1.3	.91	−1.5	.98	+1.0	1.05	+1.4	1.05			− .9	.97		
		+1.3	1.31	−2.1	.58	0	.97			− .7	.86	+ .1	1.00	0	1.00	+3.5	1.12	−1.1	.92	− .3	.99	+ .6	1.06	+2.0	1.08			+ .2	1.01		
				−1.5	.69	+ .6	.90			− .5	.88	+. 4	1.02	+ .5	1.09			−1.8	.93	+1.2	1.05	+1.3	1.11	+1.5	1.09						
				−1.3	.74	0	1.00			− .5	.89	+1.4	1.16	+ .1	1.10			−1.6	.95	+2.2	1.10	+1.5	1.15	+1.5	1.13						
				−1.0	.76	+ .3	1.06			− .7	.90	+2.0	1.21	+1.6	1.13			+2.5	1.08			+1.5	1.15								
				−1.0	.77	+1.4	1.36			− .6	.94							+4.4	1.23												
				+1.4	1.26	+1.4	1.45			− .5	.95																				
				+1.5	1.33					+ .1	.96																				
				+1.2	1.21					0	.98																				
										+4.2	1.46																				

TABLE III.

Distribution of Coefficients of Intelligence for Normal Group (1282 Individuals)

Coefficients	Age by Years 4–5	6–7	8–9	10–11	12–13	14–15	16–17	18–on	Totals
.25 or less									0
.26– .50	4	6	3		2			1	16
.51– .60	4	7	10	1	1	1		1	25
.61– .70	4	15	13	7	3	3		16	61
.71– .80	8	26	21	15	10	3		31	114
.81– .90	10	36	25	23	12	8		68	182
.91–1.00	8	49	31	39	22	24	2	109	284
1.01–1.10	7	45	37	33	40	17	1	55	235
1.11–1.20	10	55	25	21	23	16		3	153
1.21–1.30	6	46	19	16	4	3			94
1.31–1.40	6	27	9	4	2	2			50
1.41–1.50	6	21	3	2	1				33
1.51–1.75	9	19							28
1.76–2.00	0	4							4
2.01–2.25	2	1							3
2.26–2.50									
Totals	84	357	196	161	120	77	3	284	1282

TABLE IV.

Intelligence Classification According to Coefficient of Intelligence, Based upon the Data for 1282 Individuals, Ranging in Age from 4 Years to Maturity

Coefficients	Name of Class	Frequency
.50 or less	Dependent	1.25 per centum
.51– .70	Inferior	6.96 " "
.71– .90	Subnormal	23.09 " "
.91–1.10	Normal	40.48 " "
1.11–1.30	Supernormal	19.27 " "
1.31–1.50	Superior	6.47 " "
1.51–	Genius	2.73 " "

On the basis of the facts of distribution indicated by Table 3, we have made a tentative classification of intellectual ability. This is presented in Table 4, in which are to be found seven classes, ranging from the intellectually dependent to the intellectual genius. For each of these classes, the range of coefficients is indicated and the frequency or expectation in percentage terms as determined by the distribution of twelve hundred and eighty-two normal-group coefficients. Because of the excessive variation in range exhibited by Table 3, we have presented, in Table 5, the frequency of these seven groups of coefficients for four hundred and seventy-seven normal-group coefficients obtained from subjects whose chronological ages ranged from eight to thirteen years.

TABLE V.

Intelligence Classification According to Coefficient of Intelligence, Based Upon the Data for 477 Individuals, Ranging in Age from 8 to 13 Years

Coefficients	Name of Class	Frequency
.50 or less	Dependent	1.05 per centum
.51– .70	Inferior	7.34 " "
.71– .90	Subnormal	22.22 " "
.91–1.10	Normal	42.35 " "
1.11–1.30	Supernormal	22.64 " "
1.31–1.50	Superior	4.40 " "
1.51–	Genius	0 " "

We suggest this classification for certain practical purposes, hoping that it may be tried out in comparison with social measurements in order that we may determine with increasing definiteness the frequency of these significant levels of intellectual ability.

TABLE VI.

Distribution of Coefficients of Intelligence by Years, for Little Wanderers' Home Group (Hardwick)

Coefficients	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Totals
.25 or less		1						1									2
.26– .50		2	4	1					1	1							9
.51– .60	2	1	3			1											7
.61– .70			1			2	2	1			1		1	1	1		10
.71– .80		2	3	3		1			2	2			2		3	1	19
.81– .90				3	1	6	2	2	1	2	3	3			1	1	25
.91–1.00				2	3	4	3	3	1	4	3	1	1		1	1	27
1.01–1.10				1			1	2	1	1	2	4	4	2	1	1	20
1.11–1.20							1	1	1			2	1				6
1.21–1.30			2				1			1							4
1.31–1.40		1	1	1	1												4
1.41–1.50				1		1											2
Totals	2	7	14	12	5	15	10	10	7	11	9	10	9	3	7	4	135

In the group of one hundred and thirty-five individuals examined at the Little Wanderers' Home, there appear, as Table VI indicates, an unexpectedly large percentage of sub-normal and inferior individuals. Prior to the analysis of our data, we had assumed that this group of children should be classified as normal, but by comparison with the public school groups, they are so inferior that it is necessary to deal with the results separately or in connection with the Industrial School group. For this group, and likewise for the Industrial School group, as it appears in Table VII, age range is favorable to the coefficient, for the distribution under the several ages is reasonably constant.

TABLE VII.

Distribution of Coefficients of Intelligence for Ohio Industrial School Group (Haines)

Coefficients	10	11	12	13	14	15	16	17	18	19	Totals
.25 or less							1				1
.26– .50	1		1	1	3	7	6	1	2		22
.51– .60		2	4	11	19	9	8	12	3	1	69
.61– .70	1	3	1	9	19	25	12	28	16	2	116
.71– .80	1	5	10	16	28	53	38	43	24	2	220
.81– .90	4	6	12	18	32	49	44	38	18	1	222
.91–1.00	3	8	10	14	24	48	54	45	20		226
1.01–1.10		3	1	7	13	24	26	18	17		109
1.11–1.20	2	2		1	2	3	1	1			12
Totals	12	29	39	77	140	218	190	186	100	6	997

Since we are primarily interested in developing a method of expressing intellectual ability which shall be at once convenient and reliable and render possible direct comparison of measurements on different subjects, it is pertinent to consider here the relations of age-difference to coefficients of intelligence. It has long been recognized that a year of intellectual retardation or acceleration has widely varying values. Our data enable us to express this relation somewhat more exactly than has heretofore been done.

TABLE VIII.

Approximate Age-Difference Equivalents of Point-Scale Coefficient .70 for Various Ages

Age	Age-difference	Coefficient
5 years	—1.0 year	.70
6 "	—1.3 "	"
7 "	—1.5 "	"
8 "	—2.0 "	"
9 "	—1.3 "	"
10 "	—2.0 "	"
11 "	—2.5 "	"
12 "	—3.2 "	"
13 "	—4.0 "	"
14 "	—4.8 "	"
15 "	—5.6 "	"
16 "	—6.5 "	"
17 "	—7.4 "	"
18 "	—8.0 " +	"

The norm for nine years is inexact.

For the coefficient of intelligence .70, which we accept as the upper limit of intellectual inadequacy or inferiority, the age-difference equivalents for the ages five to eighteen years have been calculated and are presented in Table VIII. At five years of age, this coefficient represents a retardation in intellectual develop-

ment of approximately one year. At ten years of age, it represents a retardation of at least two years, and so on, until at the age of eighteen years it is equivalent to a retardation of approximately eight years. In view of this varying relation of coefficient to age-difference, it is eminently undesirable to continue to use the age unit as a means of expressing intellectual status.

A graphic representation of the relation of coefficients to age-difference appears as figure 1.

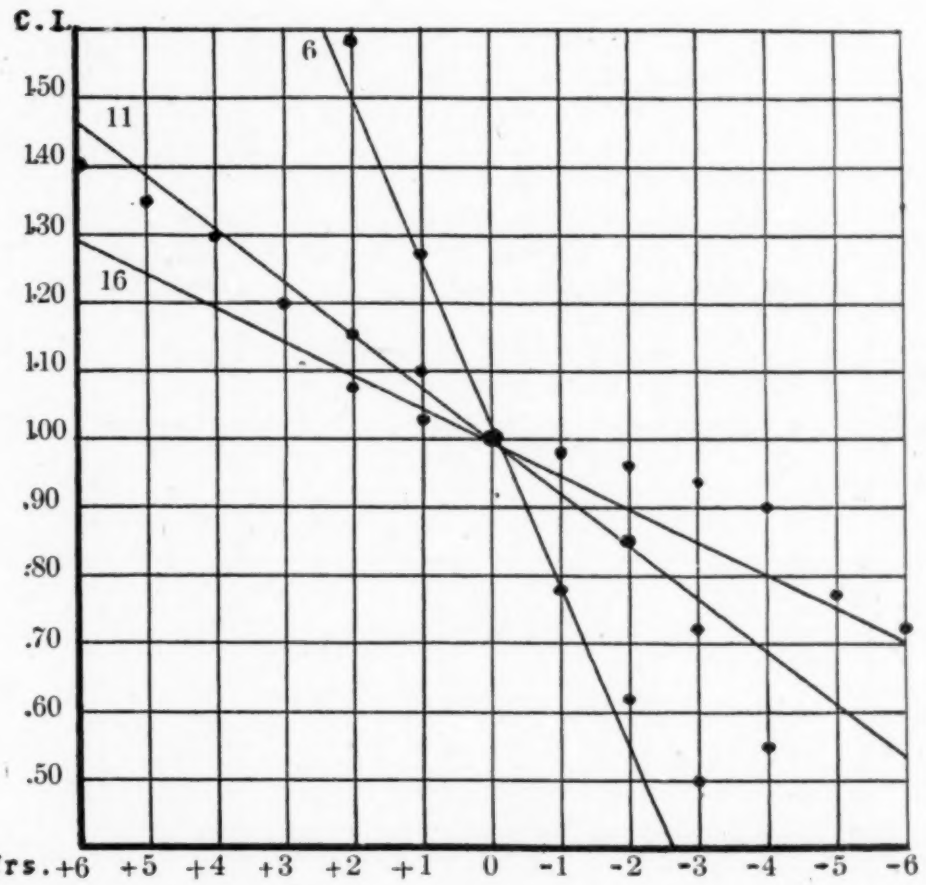


FIGURE 1—Age-difference in relation to coefficient of intelligence for the ages 6, 11 and 16 years.

The point-scale method has the merit of indicating directly the rate, or annual increments of intellectual growth. We do not claim for our measurements a high degree of accuracy, especially in case of the early years of childhood. But even the roughly determined curve of intellectual growth from four to eighteen years, which we present below, has considerable interest for the genetic psychologist and for the psychological examiner. We have ascertained that whether measured by the ratio of the

increment of increase, year by year, to the norm for the appropriate year or by the ratio of the extreme range of scores to appropriate year norms, intellectual development rapidly diminishes in rate, at least from the fifth year onward. This is shown by the curve of figure 2.

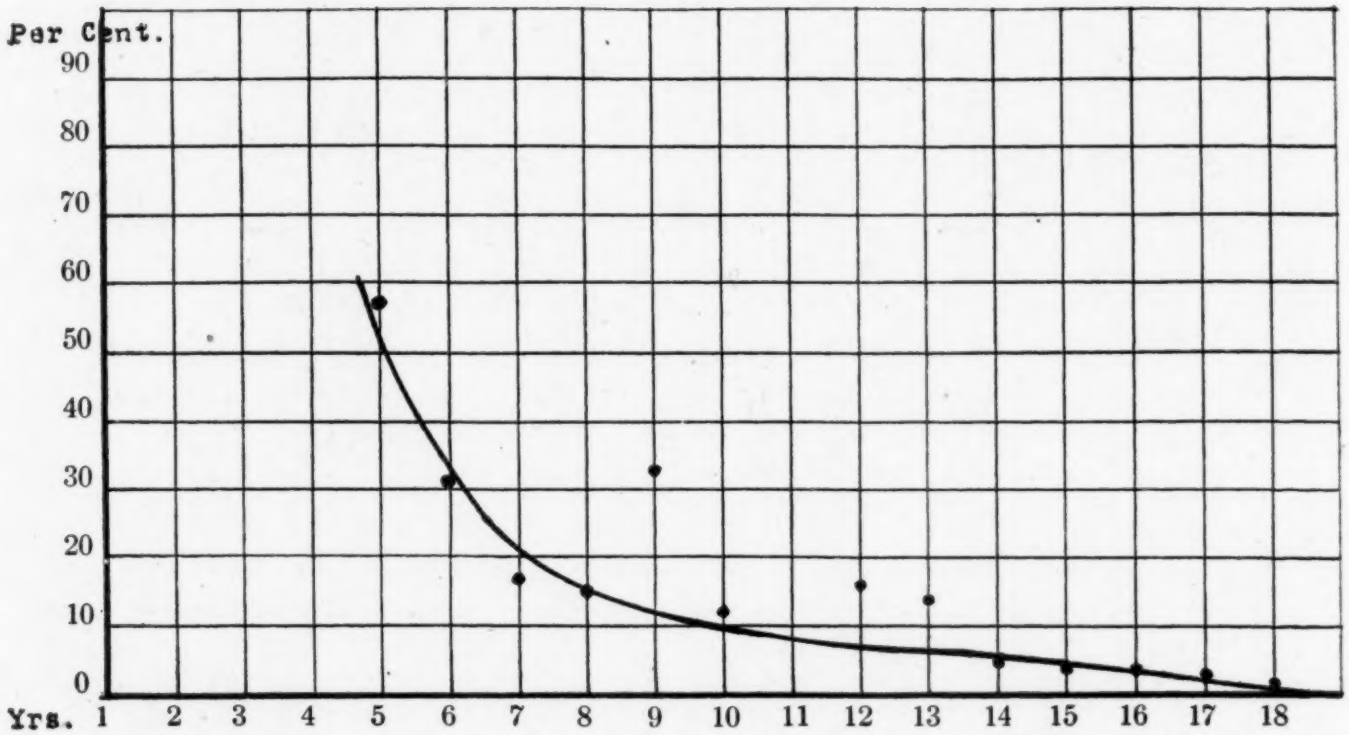


FIGURE 2—Curve of increase of intellectual ability based upon point-scale measurements.

During the fourth year of life, intellectual ability (always understood as measured by the point scale) increases by more than fifty per cent.; during the fifth year of life, by scarcely more than thirty per cent.; during the seventh year, by approximately fifteen per cent. It then develops less rapidly until in the thirteenth year it increases by only about five per cent. Our results further indicate that between sixteen and eighteen years the increase is slight and irregular, ceasing almost entirely at about eighteen years.

The application of a carefully constructed point scale to thousands of non-selected individuals evidently would yield most valuable information concerning psychogenesis, for curves might be plotted not only for examination scores but for measurements of particular functions. In this respect the point-scale method as an instrument of research has great superiority over the Binet age-grade method.

The data of Table VIII and those upon which figure 2 is based suggest an important reason for the greater range or variability of coefficients in early childhood than in adolescence. During the earlier years, intellectual ability is increasing very rapidly and any discrepancy between physiological and chronological age or any slight advantage or disadvantage in the conditions of mental measurement would naturally affect the score or coefficient of intelligence markedly, altering it by ten, twenty, or even thirty per cent. For a single case, we present the coefficients figured, first, without respect to months of age; second, with reference to exact age. A child five years, six months of age obtained a score of 45 points. The norm for the age five years is 22 points. The coefficient of intelligence is therefore 2.05. For this individual, when months as well as years are taken into account, the appropriate norm is 26 points, instead of 22, and the resultant coefficient of intelligence, 1.81.

The norms for point-scale measurements, as originally published in "A Point Scale for Measuring Mental Ability" are undoubtedly inaccurate. This is due partly to the small number of individuals in each age-group and partly to the unsatisfactoriness of the arithmetical mean as a norm. Since the norms were first published, thousands of examinations have been made by the method, and we have had opportunity to make various corrections. Unfortunately, our materials have been rather heterogeneous, and we are still unable to present a continuous series of age norms based upon comparable non-selected cases with supplementary information concerning deviations and probable errors. But despite the statistical shortcomings of our data, we deem it worth while to present herewith a new curve (figure 3) of point-scale norms ranging from four to eighteen years. Certain of these norms will doubtless have to be revised later, but we unhesitatingly recommend the present curve for English-speaking subjects as contrasted with the corresponding curve of the point-scale book.

Applications and Recommendations

The coefficient of intelligence (quotient) is the most valuable mode of expressing results of mental measurement at present available, and should, therefore, be used. Physiological age and norms appropriate thereto should be used as possible, instead

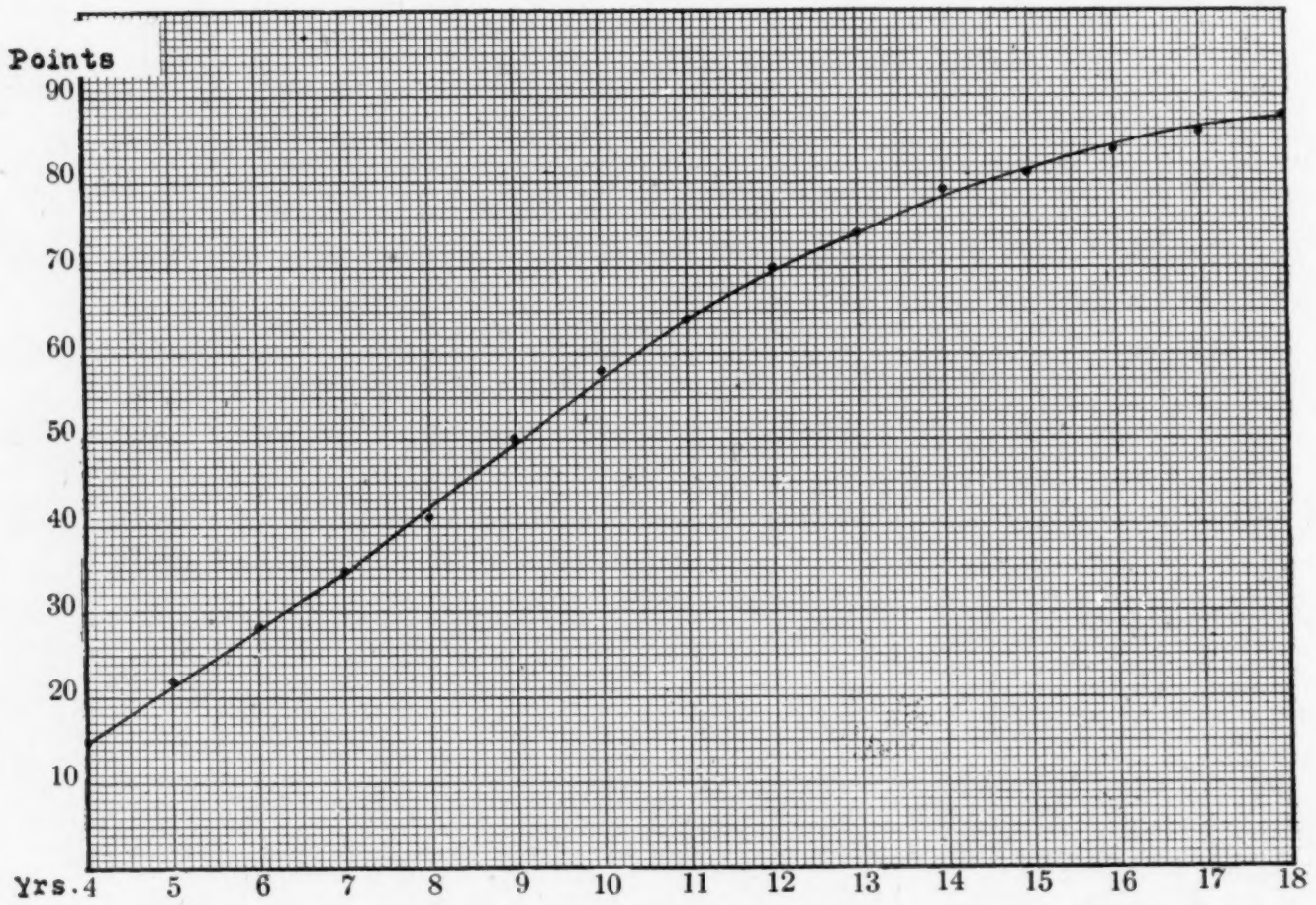


FIGURE 3—Revised point-scale norms for the ages 4 to 18 years (maturity).

of chronological age and the norms based upon the same. Frequency or rank is practically significant and should be stated. "Mental age" and age-difference as now employed are eminently unsatisfactory and should be abandoned as statements of intellectual status.

We recommend that the classification proposed in this paper be checked against social and economic measurements of individual efficiency and that the range of coefficients for the seven grades of intellect in our classification be adjusted to agree closely with expectation of performance in practical situations. Our data indicate that grades of intellectual ability measured by the coefficient .70 or less are socially burdensome, ineffective, and usually a menace to racial welfare.

COMMUNICATIONS AND DISCUSSIONS

THE COLLEGE FRESHMAN AND MATHEMATICS. SECOND REPORT

The first report given by the writer on the subject appeared in the April number of the JOURNAL OF EDUCATIONAL PSYCHOLOGY, and included data from two tests, namely, Series A and Series B of the Courtis Standard Tests in Arithmetic. The purpose of this report is to add some data obtained from tests dealing with fundamentals, and with easy reasoning in the various topics in college algebra, plane trigonometry, and analytic geometry. From this data it was hoped that some conclusion might be reached as to the efficiency to be obtained, depending on the text or texts chosen.

For several years it has been our custom in freshman mathematics to give approximately twelve weeks, four recitations per week of 55 minutes each, to each of the above named subjects in the order named, and to use different texts in diffierent sections.

In the fall of 1915–16 each section consisted of exactly thirty students chosen at random. The section meeting at 8:00 o'clock studied Fite's College Algebra, Durell's Plane Trigonometry, Wilson and Tracy's Analytic Geometry. The section meeting at 2:30 o'clock studied Rietz and Crathorne's College Algebra, Conant's Plane Trigonometry, Bocher's Analytic Geometry. The similarity of the records obtained from Series A and Series B of the Courtis Standard Tests, indicated evenly matched sections, as did also other tests such as tendency to study, enthusiasm, ability to understand new methods, etc. The first of the standard tests in algebra was given on January 5th, 1916. It consisted of four parts, namely; No. 1, addition; No. 2, multiplication; No. 3, reduction to a common denominator; No. 4, factoring. The following are type problems:

No. 1. $12X + 10 - 7X - 6 + 8X + 8 - 5X + 7 =$

No. 2. $-6(8y - 16 + 7y + 13b) =$

No. 3. $\frac{5X - 7}{4} - \frac{3X - 8}{3} + \frac{X + 2}{12} =$

No. 4. $X^2 - 3X - 10 =$

A sufficient number of problems was given so that no one would be able to complete the work within the time allowed. Seven minutes

were given for the first test; four minutes for the second; 3½ minutes for the third; seven minutes for the fourth. In tabulating the results the number attempted is indicated by Att. and the number correct by Rt.

Section	No. 1		No. 2		No. 3		No. 4	
	Att.	Rt.	Att.	Rt.	Att.	Rt.	Att.	Rt.
8:00 (o'clock)....	13.3	9.4	13	10.9	8.7	5.4	20	12.5
2:30 (o'clock)....	14.2	9.4	12.8	9.9	9.3	6	20	11.4

It will be seen that the average record in these fundamental operations is quite uniform. Yet the efficiency in solving more difficult problems was noticeably different. The 2:30 section constantly required more drill and more assistance outside the class hour. Although the spirit of this section was good, they frequently spoke of their inability to read the text, especially in the more difficult parts of the text. At the end of three months their efficiency was not over 90% of that of the other section and probably considerably less.

The data given below show the highest and also the lowest record in each section.

Section	No. 1		No. 2		No. 3		No. 4	
	Att.	Rt.	Att.	Rt.	Att.	Rt.	Att.	Rt.
8:00 (highest).....	20	18	21	19	15	12	40	29
(lowest).....	9	5	9	6	6	2	14	6
2:30 (highest).....	18	17	17	17	13	10	40	32
(lowest).....	8	1	4	0	5	0	5	1

The difference in efficiency between the highest and the lowest is very marked. Two of the three students with extremely low records failed badly in the final test, even after they had received much individual coaching. The semester grades in all subjects indicated that, in general, these fundamental tests in arithmetic and algebra had been fairly accurate tests of mentality as far as their accuracy and rapidity of thinking was concerned.

On March 7th the tests consisted of three parts: Nos. 5 and 6 were devoted to easy processes in algebra; No. 7, to fundamentals in trigonometry. In algebra the test covered L. C. M.; H. C. F.; Binomial Theorem; solving quadratic equations; forming equations whose roots were given; evaluating a determinate; etc. In trigonometry the test covered such questions as completing a formula when a part is given; functions of 30 degrees; easy identities; etc. The following results were obtained:

Section	No. 5		No. 6		No. 7	
	Att.	Rt.	Att.	Rt.	Att.	Rt.
8:00.....	12.5	6.8	11.5	5.9	11	7.5
2:30.....	12.1	6.4	9.2	4.4	9	6.7

The efficiency of the 2:30 section as indicated by these tests was probably about 85% of that of the 8:00 section. The difference between the highest and the lowest record did not indicate a greater degree of uniformity than at the beginning of the year. The last of the series of tests was given May 26th. Test No. 8 was merely test No. 7 repeated. Test No. 9 was made to cover fundamental principles and easy exercises in analytic geometry. For test No. 8, 12 minutes was given and for test No. 9, 11 minutes. The following results were obtained:

Section	No. 8		No. 9	
	Att.	Rt.	Att.	Rt.
8:00.....	12.55	7.7	11.25	7.81
2:30.....	9.54	7.05	8.66	4.33

It will be seen that the efficiency of the 2:30 section remained below that of the other section in trigonometry, and the lower standard in analytics is decidedly marked. Yet these results were in fairly close agreement with my personal grading.

After this test a strenuous effort was made to bring the 2:30 section to a higher standard. The success was only partial, and on June 4th, a final test over the semester's work, taking 2½ hours time revealed the fact that there was still a difference of about 11%. I attribute the difference in the final standard of efficiency to the text or texts used.

Of the students who enrolled for calculus in September, 1916, exactly four-fifths came from the 8:00 section. Why teach mathematics from a poorly written text?

EMERY E. WATSON.

Parsons College, Fairfield, Iowa.

MEASURES OF DIFFICULTY IN COMPLETION TESTS

May I venture to point out what appears to be a somewhat serious error in the June number of the JOURNAL OF EDUCATIONAL PSYCHOLOGY, in a paper entitled "*A Tentative Standardization of the Completion Test.*" On page 332, the authors make the following statement: "In other words, these three degrees of difficulty are purely subjective degrees determined by the observer, and hence the less frequently words are marked as of more than average difficulty, the more difficult they probably are compared with words of average difficulty, and the more value they should be assigned in comparison with the easier words. Hence the conclusion that the best method

of assigning the values to the different blanks of the test should be based on the frequency with which such degree of difficulty was specified by the different subjects." That is, the assumption is made that an inverse rectilinear relationship exists between the frequency with which a particular judgment of difficulty is given and the amount of difficulty which that judgment implies. While undoubtedly it is true that the more rarely a particular judgment, such as "more than average difficulty" is applied by a group of examiners to a series of samples, the more likely it is that the standard represented by "more than average difficulty" is high, yet to assume that an actual rectilinear relationship exists would seem contrary to all previous statistical work.

This can be clearly shown by an extreme example. Suppose we have one hundred individuals judging one hundred elisions by classifying them into samples of "average difficulty" and "more than average difficulty," and let us suppose that in the one hundred samples, all but one are of uniform difficulty with the rest; this one being of just sufficient increased difficulty to cause one judge to assign it to the group of "more than average difficulty." Then if we consider the 10,000 judgments, grouping all the individuals and all the judgments of the elisions together, *as in the original paper*, then

9999 of the judgments were given to group of "average difficulty"
1 " " " was given to group of "more than average difficulty"

Using the method of calculation which the authors employ, we should now conclude that the judgment "more than average difficulty" indicated an amount of difficulty 9999 times the amount implied by the term "average difficulty." This, on the surface, is absurd, yet it is precisely the method employed in the study, though there the error is not so obvious simply because it is veiled by not being shown in an extreme form.

If it is desired to determine the relative difficulties of the elisions or the judgments "average difficulty," more than average difficulty," "very difficult," the most direct method would be to measure the actual time taken by all the subjects for the completion of each of the elisions, then on the basis of these times defining the values of the difficulties.

It would not have been necessary to call attention to the above error had it not been so destructive of the final quantitative values which it was the aim of the paper to determine.

J. Crosby Chapman.

Western Reserve University.

THE

JOURNAL OF EDUCATIONAL PSYCHOLOGY

INCLUDING EXPERIMENTAL PEDAGOGY, CHILD PHYSIOLOGY AND HYGIENE, AND EDUCATIONAL STATISTICS

Edited by

W. C. BAGLEY, C. E. SEASHORE,
J. CARLETON BELL, Managing Editor. GUY MONTROSE WHIPPLE.

Published monthly except July and August by
WARWICK & YORK, INC.,
LANCASTER, PA. BALTIMORE, MD.

Manuscripts for publication, books or other material for review, and news items of interest to educational psychologists should be addressed to The Managing Editor, J. Carleton Bell, 1032A Sterling Place, Brooklyn, N. Y. Research contributions from England may be sent to W. H. Winch, Esq., Melville Villa, Overhill Road, Dulwich, London.

The Journal is issuing a series of Monograph Supplements for the publication of more extensive researches in educational psychology. For details prospective contributors may apply to Guy Montrose Whipple, University of Illinois, Urbana, Ill.

The price of the Journal is $3.00 per year of ten monthly issues. Foreign postage is 20 cents extra for Canada and 30 cents for other countries in the Postal Union.

Subscriptions and correspondence concerning business matters should be sent to Warwick & York, Inc.

VOLUME VII DECEMBER, 1916 NUMBER 10

EDITORIAL

THE INFLUENCE OF ALFRED BINET

The translation into English under the auspices of the Vineland Training School of the papers of Alfred Binet and Th. Simon on *The Development of Intelligence in Children* and *The Intelligence of the Feeble-Minded* invites attention to Binet's life and influence. Binet's early training was along neurological and psychiatric lines—he was first a pupil of and then an assistant to the great Charcot. Attracted by the German experimental movement in psychology, he went to Germany in the early nineties, and on his return established the first laboratory for experimental psychology in France. From this laboratory, consisting of a few small, dark, poorly equipped rooms in an old dwelling house on a little side street, Binet for twenty years radiated a stimulating and broadening influence upon the psychological thinking not only of France but of the whole world.

The channels for the exercise of this influence were three fold: The *Année Psychologique*, the publication of books on various aspects of psychology, and the investigations of the *Societé libre pour l'etude psychologique de l'enfant.* In the *Année* Binet and his associates published a number of articles each year, usually of a general rather than of a technical experimental nature, and gave a complete *resumé* of the progress of psychology during the preceding year. These

resumés furnish an excellent sketch of the development of the science, and will be valuable for the future historian of the subject. Binet's books cover a wide variety of topics, ranging from the psychology of micro-organisms, through suggestion, graphology, and chess playing, to the psychology of the reasoning processes. These were all written in a popularizing vein, and show none of the efforts at profundity that characterize most German and American books on psychology. Throughout his whole life Binet was greatly interested in educational problems, and a large amount of space in almost every volume of the *Année* was devoted to questions of a psycho-educational nature. His educational proclivities found immediate expression in the work of the *Societé libre*, of which he was an active and zealous member.

Binet was not, perhaps, a great teacher. His lectures did not fill large auditoriums with eager proselytes, nor was his laboratory a training camp for a host of investigators, who made it their mission to enlarge the boundaries of the science, and to become centers of psychological research in other communities. Perhaps the conditions in France were not favorable for this. Experimental psychology in France has always meant medical psychology, and there seems to be little interest in the laboratory studies of normal individuals which have characterized the term in Germany and America. It would probably not be too much to say that Binet was never an experimentalist in the sense in which that term is understood in the laboratories of Wundt and Titchener. His work contains little of mathematical or statistical method. In studying his papers on measuring the intelligence of children the reader is oftentimes at a loss to know just what experimental work was done or how the resulting judgments were arrived at. The detailed steps of his procedure are passed over hastily, the methods of computation determining the final placing of tests are ignored. His attention was fixed on the final result, and he was perhaps too careless of the means by which the result was attained. His great service to psychology and education lay in the genius with which he seized upon great ideas and set them forth so that they stimulated the imagination and led to reflection and investigation.

J. C. B.

NOTES AND NEWS

Dr. Herman M. Adler, assistant professor of psychiatry, Harvard University, has commenced a study of the facilities for dealing with mental diseases and mental deficiency in Cook County, Illinois. The survey is under the general direction of the National Committee for Mental Hygiene and the expense will be meet by the Rockefeller Foundation. A committee appointed by the mayor of New York City to present a constructive plan for the examination, classification and proper treatment of mental defectives has requested the National Committee for Mental Hygiene to make a similar survey of New York City. Thus studies of the same subject will be carried on simultaneously under the same general direction in the two largest cities of the country.—*Science.*

The Jesup Lectures of the American Museum of Natural History are being given this year by Professor Robert S. Woodworth, of Columbia University. The general subject is "Dynamic Psychology," and the subjects of the individual lectures, which are delivered on Friday evenings from November 10 to December 29, are as follows: "The Modern Movement in Psychology," "The Problems and Methods of Psychology," "Native Equipment of Man," "Acquired or Learned Equipment," "The Factor of Selection and Control," "The Factor of Originality," "Drive and Mechanism in Abnormal Behavior," and "Drive and Mechanism in Social Behavior."

On November 29–30 Professor W. C. Bagley delivered a series of six lectures before the North Carolina Teachers Assembly on the general subject of "Problems of Educational Psychology and Administration."

On December 9 Professor Guy M. Whipple addressed the forty-second semi-annual meeting of the New Jersey High School Teachers Association on the subject of "Standardization of Marks in High School Subjects."

In connection with the reorganization of the work in education at Johns Hopkins University the degree of Bachelor of Science is offered to those students who desire to emphasize education in their undergraduate work. The usual fifteen units are required for matricula-

tion, but the course is made as flexible as possible to permit of adjustment to the future work of the student. Courses are required in English, foreign languages, history and science, and in history of education, psychology, educational psychology, psychopathology, hygiene and political economy. Elections may be made in the fields of elementary or secondary teaching, supervision, or educational administration, but at least two courses are required in two teaching subjects.

The Board of Trustees of the University of Illinois has approved plans for a building for the school of education calling for a preliminary expenditure of $600,000. Ground has already been broken for the erection of the first wing.

At the Culver (Indiana) Military Academy Professor Guy Montrose Whipple and other psychologists with selected cadets as assistants have been conducting experimental studies on the feasibility of mental tests as a means of diagnosing abilities in applicants for admission.

Dr. Bird T. Baldwin, professor of psychology and education at Swarthmore College, has been appointed lecturer in education at Johns Hopkins University. In addition to his work at Swarthmore, Dr. Baldwin will give a graduate course in physical and mental measurements, tests, and scales in the new University Administration Building at Homewood, Baltimore.

At the University of Washington, Dr. Leonard V. Koos has been made associate professor of education, and Dr. Clifford Woody has been appointed assistant professor in the same department.

Professor George O. Ferguson, Jr., of William and Mary College, has been appointed associate professor of psychology and education in Colgate University.—*School and Society.*

Mr. B. F. Pittenger, who was appointed associate in education at the University of Illinois for the current year, has accepted a position as adjunct professor of education in the University of Texas.

Professor W. H. Pyle, on leave of absence from the University of Missouri, is giving courses in educational psychology at the University of Indiana.

PUBLICATIONS RECEIVED

HENRY FOSTER ADAMS. *Advertising and Its Mental Laws.* New York: The Macmillan Company, 1916. Pp. xi, 333. $1.50.

The work of Scott, Münsterberg, Hollingworth, Strong and Starch has caused attention to be focussed upon the psychology of business and upon advertising in particular, and has been productive of much interesting and valuable material anent the subject. It might seem daring to add another book at the present time to the considerable number already in the field, but the volume before us produces a very favorable impression. It is not a "one man book" by any means. The author has made very skillful use of the findings of previous investigators, and has furnished a reliable and scientifically constructed handbook. But it is not merely a compilation. The author has interesting investigations of his own to report on almost every topic. The aim of the book, as set forth in the preface, is "to present the basic principles of psychology which are related to advertising and to point out their application; to reduce the complexity of an advertisement to its elements and to show with mathematical exactness the effect of the various elements; and to compare the results of the experiments carried on in the laboratory with the results of actual advertising campaigns, showing the strikingly close relationship between the business and the theoretical test."—An ambitious undertaking, truly, but carried out with no inconsiderable degree of success.

FRED CARLETON AYER. *The Psychology of Drawing, with Special Reference to Laboratory Teaching.* Baltimore: Warwick & York, Ind., 1916. Pp. 172. $1.25.

This is an important contribution to the literature of experimental education. The book consists of three parts: Part I, "The Scope of the Problem," is by way of introduction. Part II, "Survey of the Literature of Drawing," gives an excellent history of the subject to date. It includes a consideration of the methods of research, the relation of drawing to intellectual development, the analysis of the drawing product, and the analysis of the drawing act. It is particularly the latter chapter in which the psychologist is interested, and here one will find a good condensed account of the work of Albien, Meumann, and Judd. In Part III, "Experiments and Conclusions," there is an account of some interesting and significant studies on representative drawing, description, and diagrammatic or analytical drawing. Representative drawing the author finds useless for scientific purposes, and he condemns it as positively antagonistic to the development of scientific thinking. "The psychological analysis of the drawing act shows that there is great variation among different individuals in the ability to draw and in the manner in which graphic expression is utilized. Laboratory procedure must be adapted to these variations before the highest type of instruction is attainable." The investigation points the way to a saner and more efficient use of drawing in laboratory work in science.

ALFRED BINET AND TH. SIMON. *The Development of Intelligence in Children.* Translated by Elizabeth S. Kite. Publications of the Training School at Vineland, New Jersey, Department of Research, No. 11, May, 1916. Pp. 337. $2.00.

ALFRED BINET AND TH. SIMON. *The Intelligence of the Feeble-Minded.* Translated by Elizabeth S. Kite. Publications of the Training School at Vineland, New Jersey, Department of Research, No. 12, June, 1916. Pp. 328. $2.00.

Just as America owes to Dr. H. H. Goddard the first agitation for familiarity with and use of the Binet tests, so now she owes to his interest and initiative the publication of these two stately volumes containing translations of many of Binet's most important papers. In the past eight years the Binet tests and Binet testing have developed from a tentative psychological proposal to the formidable proportions of a veritable cult. In many institutions the use of the tests has become a routine procedure, and they have even been advocated as a means of grading in the public schools. Their indiscriminate and uncritical application by untrained and over-sanguine workers has led to sweeping conclusions and hasty judgments that a greater familiarity with Binet's original writings might have checked. These papers were scattered through various numbers of the *Année Psychologique*, a periodical not easily accessible, and presenting the barrier of the foreign language as a handicap to most readers. Through the labors of Miss Kite they are now made available to English readers. The first volume contains five articles, three from 1905 (the third one contains the 1905 tests), the 1908 revision of the tests, and a fifty-five page article discussing and explaining the 1911 revision. The second volume contains three parts: Part I, "The Intelligence of the Feeble-Minded," Part II, "The Language of the Feeble-Minded," and Part III, "Feeble-Mindedness and Dementia." All three of these papers date from 1908 and 1909. Like all of Binet's work, these papers contain many brilliant and stimulating reflections, and they should be carefully read by every one engaged in mental testing or interested in the problem of the sub-normal.

ERNST R. BRESLICH. *Second-Year Mathematics for Secondary Schools.* Chicago: The University of Chicago Press, 1916. Pp. xx, 348. $1.00.

The experiment to do away with the traditional divisions of secondary mathematics into algebra and geometry, and to provide a unified mathematics course, such as the Germans have, is one that is being watched with great interest by many teachers of mathematics and students of current educational movements. The present book is intended to carry on the author's *First-Year Mathematics*, published last year, but it may also be used successfully in classes that have had only algebra during the first year. The emphasis is now

on geometry, just as the emphasis in the First-Year book was on algebra, yet there is abundant material calling for a review and extension of the algebra already studied. Further aims of the book are to train the student in space geometry as well as in plane geometry, and to give a good introduction to trigonometry. The commendable features of Book I, emphasis on the historical development of mathematics and the abundant use of illustrations from actual life, are continued in the present volume. The general plan of the book is so attractive that one has a desire to try it out immediately with a class.

ANTON JULIUS CARLSON. *The Control of Hunger in Health and Disease.* Chicago: The University of Chicago Press, 1916. Pp. vii, 319. $2.00.

The past few years have witnessed a remarkably fertile activity in the field of physiology. The work of Sherrington on the functions of the nervous system, of Verworn on the irritability of nervous and muscular tissue, of Haldane on breathing, of Cannon on digestion, and now of Carlson on hunger has been of the first rank in enlarging our knowledge of the functioning of the human organism. The present book, while strictly scientific in its temper and treatment, takes account of some of the broader biological and social aspects of hunger, and is not too technical to be read with profit by the intelligent layman. Not a little of the interest of the book is derived from a detailed study of the stomach conditions of a man who has eaten nothing for twenty years. At the age of eleven, as a result of accidentally drinking a strong solution of caustic soda, his esophagus was permanently closed, and since then he has been obliged to feed himself through a tube opening directly into the stomach. This opening is large enough to permit direct inspection of the interior of the stomach, and has afforded an excellent opportunity to study the physiology of hunger.

THOMAS CHROWDER CHAMBERLIN. *The Origin of the Earth.* Chicago: The University of Chicago Press, 1916. Pp. xi, 271. $1.50.

The origin of the earth has provoked the imagination ever since the dawn of human thinking. Almost every people has its creation myth, every child sooner or later wrestles with the problem, and scientific discussions of the subject make a strong popular appeal. The prevailing theory is that the earth was once a molten, nebulous, gaseous mass at an extremely high temperature, and that the solidification of the earth's crust has come about through a process of cooling and condensation. Recent studies of the behavior of gases, however, have made such a theory increasingly untenable, and in the present book the author submits it to a searching critical analysis from every possible point of view. His own theory is too elaborate to be expounded here, but the essence of it is that the earth grew up largely by the accession of planetesimal dust after it had been wafted to and fro by the atmosphere. The accessions were solid matter, and remained solid except as specific conditions enforcing liquefaction arose

and reduced selected portions to the molten state. The author's final word is "that what we conveniently regard as merely material is at the same time spiritual, that what we try to reduce to the mechanistic is at the same time volitional, but whether this be so or not, the emergence of what we call the living from the inorganic, and the emergence of what wec all the psychic from the physiologic, were at once the transcendent and the transcendental features of the earth's evolution."

EDWIN LEAVITT CLARKE. *American Men of Letters, Their Nature and Nurture.* New York: Columbia University Studies in History, Economics and Public Law. Longmans, Green & Co., Agents, 1916. Pp. 169. $1.50.

This important study took its rise from the theory of the significance of education enunciated in Ward's Applied Sociology. An introductory chapter outlines representative views on the relation of heredity and environment in the production of great men, taking Galton, Ward and Cooley as types. One thousand of the most eminent American men of letters, born before 1850, were selected for careful study. The author's concluding thesis is: "In all ranks of American society there have been found men and women of literary ability. Much of this ability has been found in members of the same families, but it has been the monopoly of neither a select group of families nor of a peculiar national strain. This latent ability has been brought to light by favorable environmental influences, of which there are two distinct kinds. One kind may be called education, or training, and includes those influences of home and school which are particularly potent during childhood and youth. The other kind includes all the remaining elements of environment, especially the ideals and customs of the group in which one lives. Possession of even the best advantages at home and in school has made possible the development of great authors only when supplemented by this second factor of the environment. In short, men of letters have appeared chiefly when the society of their time has appreciated and demanded literature."

GEORGE VAN NESS DEARBORN. *How to Learn Easily. Practical Hints on Economical Study.* Boston: Little, Brown & Co., 1916. Pp. xi, 227.

This is a series of most entertainingly written papers on the essentials of study. Chapter I, Economy in Study, develops the doctrine of interest and satisfaction in learning, and enumerates many of the factors involved in raising this satisfaction to the maximum. Chapter II, Observation and the Taking of Notes, lays weight on the importance of so-called "sense training," and the utilization of previous experiences through the aid of written records. If one desires to fix in mind the plot of an ordinary story the best way to do it is to make a written abstract of it. There are many helpful suggestions on note taking and note using. Other chapters are entitled "Educative Imagination," "Books and their Educative Use," "Is your 'Thinker' in Order," and "Examination-Preparedness." "Originality, ingenuity, grace, skill are terms for various phases of the productive and

efficient constructive imagination. We may suggest a working rule for becoming able in this line of constructive imagination, even if it be in almost slang terms: Get posted; get energetic; get interested; get busy; and try. And keep on trying."

STEPHEN PIERCE DUGGAN. *A Student's Text-book in the History of Education.* New York: D. Appleton and Company, 1916. Pp. xiii, 398. $1.25.

All student's histories of education must necessarily be much alike. The most important differences are those in points of view and relative emphasis. The aims of the author in constructing the present text were as follows: Practical assistance to the teacher in giving him a better understanding of present-day problems in education; emphasis on modern education, particularly the tendencies of the present time; it is a history of education, not a history of pedagogy; it aims to explain how western civilization developed the educational ideals, content, organization, and practices which characterize it today. It has for its primary purpose the explanation of the way in which each people has worked out the solution of the great problem that has confronted every people at all times, in all places, and in all stages of development, namely, the reconciliation of individual liberty with social stability. In keeping with these aims we find chapters on present tendencies in education, discussing education for defectives, the Montessori system, the Gary system, school surveys, and Dewey's educational theories; and on national systems of education, sketching the history of education in the last century in America, Germany, France and England. The increase in the cost of paper is probably the reason for the rather inferior quality of stock on which the book is printed.

JOHN WILLIAM HALL AND ALICE CYNTHIA KING HALL. *The Question as a Factor in Teaching.* Boston: Houghton Mifflin Company, 1916. Pp. viii, 189.

The major portion of this book is taken up with the use of the question in teaching stories to children of the first five grades. In his introduction Professor Frank McMurry says, that in school and college procedure there is little use for the question except as a test of results after the learning process is supposed to have been completed. In most text-books the questions come in only at the end of the chapter. In practical life the procedure is reversed. No one thinks of undertaking anything except in response to a question. "Answers alone, without the problems that called them forth, would be absurd. So in the field of business in general, of politics, and of scientific investigation, questions necessarily precede answers; they are prerequisite to all thinking; they supply the motive for the effort as well as the basis for the selection and organization of the data. They are the key to the situation, determining the value that shall be attached to the answer itself." The final chapter deals somewhat cursorily with the question as a factor in teaching other subjects, as history, composition, manual training, reading, and arithmetic.

NELLIE P. HEWINS. *The Doctrine of Formal Discipline in the Light of Experimental Investigation.* Educational Psychology Monographs, No. 16. Baltimore: Warwick and York, Inc., 1916. Pp. viii, 120. $1.25.

The first 48 pages of this monograph are devoted to a summary of psychological and pedagogical experiments on the subject of formal discipline. These are classified as follows: Psychological, (1) Effect of training of one kind of sensitiveness on other kinds; (2) Effect of special training on the general rapidity and accuracy of motor adjustments; (3) Effect of special training on the general rapidity and accuracy of memorizing; (4) Effect of training of one organ upon the bilaterally symmetrical one, or closely related member. Pedagogical, (1) Mathematics; (2) Spelling; (3) English Grammar; (4) Mental traits; (A) Memory, (B) Habits, (C) Concentration of attention, (D) Observation, (E) Quickness, accuracy, attention, etc., (F) Ideas of method, (G) Ideals. The latter part of the monograph gives an account of the author's own experiments with three classes of freshman pupils in a New York City high school on "the training of observation" in biology work. There were three series of thirteen tests each, and they included such material as observation of a twig, a picture, a flower, nonsense syllables, a branch of lilac leaves, a nonsense figure, a chart of geometrical figures, a figure drawn in the air, and specimens of plants, flowers and vegetables. The results gave decisive evidence of improvement in one type of observation carried over to other kinds. The book is a valuable contribution to this much disputed topic.

HARRY L. HOLLINGWORTH. *Vocational Psychology: Its Problems and Methods.* New York: D. Appleton and Company, 1916. Pp. xviii, 308. $2.00.

In view of the current interest in the psychology of business, in vocational and educational guidance, and in the obligation of the schools not only to offer training in specific lines, but to help the pupil discover the kind of work for which he is best adapted and to assist him in making the best possible preparation for that work, the present book is very opportune. The scheme of the book is indicated by the chapter headings, some of the most important of which are as follows: Motives and antecedents of vocational psychology; search for phrenological and physiognomic principles; development of psychological tests; psychographic methods; special vocational tests; self-analysis and estimates of associates; the school curriculum as a vocational test; determinants of vocational aptitude; vocational aptitudes of women; and psychological tests as applied to vocational analysis. The ultimate goal of vocational psychology is the detailed and accurate determination of the traits involved in every form of productivity, and such tests for these traits in any individual that both employee and employer may know to what extent the individual

possesses the traits desired. The author admits that as yet we are far from this goal. But the very fact that such a systematic presentation of the aims of the science and the work already done has now been made is an indication of great promise for the future development of the subject.

WILLIAM HEARD KILPATRICK. *Froebel's Kindergarten Principles Critically Examined.* New York: The Macmillan Company, 1916. Pp. xii, 217. $.90.

"The general aim of this book is to help spread the reform of kindergarten theory and practice. Its appeal is accordingly not only to kindergartners and to the general student of educational theory, but as well to superintendents and other directors of educational practice. The complete kindergarten reform must be the work of all. Until the superintendent can know and properly value what goes on in the kindergarten, his part in improving conditions will be negligible or worse. The kindergartner herself will prove efficient in bettering affairs in the proportion that she can see and appraise what she does. Until the general student of education can place the theory of the kindergarten into its proper correlation with an all-inclusive educational theory, until that time will the kindergarten exist as a thing apart, ill connected with other educational endeavor." The author devotes two chapters to the examination of the principles underlying Froebel's educational doctrines, and one each to Froebel's educational psychology, the kindergarten gifts and occupations, and additional elements of the kindergarten curriculum.

HERBERT SIDNEY LANGFELD AND FLOYD HENRY ALLPORT. *An Elementary Laboratory Course in Psychology.* Boston: Houghton Mifflin Company, 1916. Pp. xvi, 147. $1.75.

The aim of this laboratory manual is simplification. The authors have selected seventy-eight experiments, a few of which require elaborate apparatus, and all of which have such specific and complete directions that they can be performed by the novice in psychology. The book is replete with illustrations of apparatus, plans for tabulating the results, and reproductions of test blanks. As a substitution test the authors have introduced the Continental Wireless Telegraph Code. The book follows the traditional classification: Sensation (33 experiments) perception (22), attention (2), motor processes (2), association (2), memory 9, imagery (3), and affection (5). The experiments that might have some significance for the educationist are span of perception (with an elaborate description of the Dearborn-Langfeld tachistoscope), the synthesis of successive perceptions in perceiving words and meanings, fixation of attention in word perception, influence of form in word perception, skeleton words, determining tendency in perceiving words, errors of perception (neglect of misspelling), strength of attention, free chain association, detection of suppressed ideas, and the nine memory experiments.

JOHN T. MCMANIS. *The Study of the Behavior of the Individual Child.* Baltimore: Warwick and York, Inc., 1916. Pp. 54. $.75.

It must be admitted that the traditional psychology of the text-books is extremely abstract and very far removed from the situations which the teacher is called upon to meet. This abstractness and aloofness of the subject is causing teachers of psychology in normal and training schools to reflect seriously upon the results of their work, and to modify it in such a manner as to make it function more immediately in the tasks of teaching. The present volume is the outcome of such an effort. The author, who is professor of education in the Chicago Normal College, devised this syllabus to assist prospective teachers in classes in education to understand child life in the city. "In doing this work it has been found more effective to study individual cases rather than the child as a type or children in general." The topics considered are general method, physical conditions, home conditions, plays and games, instinctive activities, outside interests, school life, mental characteristics and disposition, learning process, language, drawing, movements and motor ability, moral characteristics, and the exceptional child. Each topic has a brief introductory discussion, a study outline, and a selected bibliography. The bibliographies are especially to be commended as well-chosen, up-to-date, and excellently adapted to give the reader a thorough-going orientation in the subject. The use of this book in normal schools will do much to make the subject of child study of practical value to the young teacher.

CYRUS D. MEAD. *The Relations of General Intelligence to Certain Mental and Physical Traits.* Teachers College Contributions to Education, No. 76. New York: Teachers College, Columbia University, 1916. Pp. 117. $1.50.

"This series of studies represents data collected and tests made upon about 430 feeble-minded children of the Indiana School for Feeble-Minded Youth at Fort Wayne and 480 normal children of the Caldwell, New Jersey, public schools." Chapters two and three on the age of walking and talking in relation to general intelligence and on height and weight of children in relation to general intelligence have already appeared in the *Pedagogical Seminary.* The other chapters of this monograph deal with strength of grip, dextrality, perception, and memory in relation to general intelligence. In all the functions tested the normal subjects make a better showing than the feeble-minded.

GEORGE ORDAHL. *A Study of Fifty-three Male Convicts.* Reprinted from the Journal of Delinquency, Vol. 1, No. 1, March, 1916. Pp. 21.

This is a study of some of the convicts in the Joliet penitentiary, Joliet, Illinois. The study includes an examination of the prison records, a detailed account of the prisoner's life history as given by himself, and the application of the Binet tests for the determination

of intelligence. Fourteen of the prisoners are said to have committed their crimes either because of, or under conditions of, such a low grade of mentality as to warrant the application of the term feeble-minded. There is an interesting discussion of the significance of the Binet tests for this purpose, and while the author considers them the best means available, he emphasizes the need for finer laboratory tests and more scientific means of observation of general behavior.

MAURICE PARMELEE. *Poverty and Social Progress.* New York: The Macmillan Company, 1916. Pp. xv, 477. $1.75.

This is a scholarly and closely reasoned study of the causes of poverty and its significance for society. Under causes and conditions the author discusses biological factors; diseases of the body; mental infirmities; the distribution of wealth; standards of living; the extent of poverty; statistics and causes of unemployment; the sweating system and other labor conditions causing poverty; population and poverty; and political, domestic, and matrimonial maladjustments. The latter half of the book is devoted to a discussion of remedial and preventive measures, among which the author enumerates the modern humanitarian movement, private and public philanthropy, the care of dependents and defectives, eugenic education, thrift, social insurance, regulation of wages and the labor supply, redistribution of income from ownership of property, increasing the productiveness of society, industrial democracy, political reorganization of the democratic state, and a final chapter on social progress and the coming of the normal life. One of the most interesting chapters in the book is that dealing with eugenics propaganda. The author emphasizes the play function of sex and shows the futility of attempting to reduce sex relations to the specific end of the propagation of the species.

MARY L. READ. *The Mothercraft Manual.* Boston: Little, Brown and Company, 1916. Pp. xix, 440. $1.25.

This is a meaty and practical book on a most important topic. The author, who is director of the School of Mothercraft, New York, enumerates the following ideals that have been kept in mind in its preparation: "To write a handbook that is so definite, concrete and clear that the least experienced person of average intelligence will find it practical; to bring directly to those who have opportunity to use it some of the wealth of present knowledge in biology, dietetics, hygiene, domestic efficiency, child psychology, and education that is stored in the laboratories, research reports, medical records, technical journals, and educational classics, translating these from the obscure tongue of technical language into the clearer speech of daily life; to present fundamental principles and facts rather than mere rule of thumb procedure; to keep a progressive yet reserved attitude between conservative and radical theories; and to lighten the burden and enlighten the minds and hearts of earnest young people so that with joy and satisfaction they may essay and find the home and family life that their hearts desire." We know of no other book that attains so nearly to these ideals, that contains so much valuable material

for the prospective mother, for the care of early infancy, and for the nurture and development of the young child. An appendix provides an excellent bibliography of 43 pages.

HAROLD ORDWAY RUGG. *The Experimental Determination of Mental Discipline in School Studies.* Educational Psychology Monographs, No. 17. Baltimore: Warwick and York, Inc., 1916. Pp. ix, 132. $1.25.

The subject of the general effects of special training shows no diminution of power to attract the attention of students of education. Indeed there are evidences that the experimental investigation of this topic is only at its beginning. The present volume is noteworthy in two respects: First, it presents in condensed, tabular form the results of the important studies on the subject up to the present time; second, it gives an account of the most elaborate experiment ever undertaken to determine the spread of improvement in a school subject to types of activity of a markedly different nature. It is somewhat surprising to note that prior to 1890 no empirical study of the problem of mental discipline had been made, and up to 1900 only three studies were published—all of a formal, psychological nature. In the past sixteen years, however, thirty experimental studies have been published, and six of these have had to do with school activities. The experiment reported in this monograph dealt with the effects of the study of descriptive geometry upon "the quickness and accuracy with which the verbal description of different types of spatial elements (whether plane figures or three dimensional objects) raises in consciousness and maintains and manipulates in consciousness a corresponding mental picture or spatial 'visual image.'" The method was that of parallel groups, one the training group, the other the control group. Both groups were given the test series immediately before the training was begun, and immediately after it was ended. The results showed that there was a greater gain on the part of the trained group than of the untrained group, that the greater gain was slight in non-geometrical abilities and became increasingly greater as one passed to those partaking more and more of geometrical qualities, and that the gainers of the trained group gained in a distinctly larger proportion of the tests than did those of the untrained group.

W. CARSON RYAN, JR. *Education Exhibits at the Panama-Pacific Exposition, San Francisco, California, 1916.* Bulletin, 1916, No. 1. Washington: Bureau of Education, 1916. Pp. 116. 25c.

A detailed account of the educational exhibits with a large number of excellent photographs showing their precise nature.

WILLIAM A. STECHER. *Games and Dances.* Philadelphia: John Joseph McVey, 1916. Pp. xiv, 255. $1.50.

The book contains detailed directions for over 250 games arranged according to the age of children, the conditions under which the games may be played, and other needs. Music and words are given for the games and musical accompaniments for the dances. The book constitutes a very valuable manual for physical education.

INDEX TO NAMES

Authors of original articles, communications or discussions have names printed in CAPITALS, and page numbers in **bold face** type. Authors reviewed, contributors of reviews, and authors mentioned have page numbers in Roman.

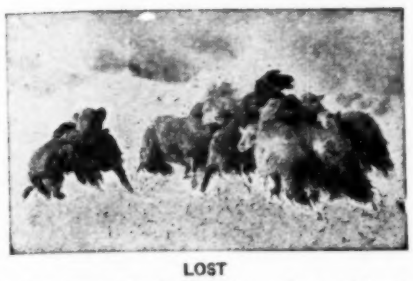
ANDERSON, HOMER W., **400**
ANDERSON, J. E., **445**
ANGELL, JAMES R., **229**
Bagley, W. C., 361
BELL, J. CARLETON, **39**, 46, 116, 167, **381**, 436, 440, 498, 557
Binet, Alfred, 616
BINGHAM, W. V., **129**, **230**
BLANTON, SMILEY, **253**, **581**
BONSER, FREDERICK G., **187**
BRONNER, AUGUSTA F., **238**
BUTTERWORTH, JULIAN E., **329**
CHAPMAN, J. CROSBY, **609**
CHASSELL, LAURA M., **317**
CHRISTIANSEN, A. O., **445**
COWAN, EDWINA ABBOTT, **31**
CUNNINGHAM, K. S., **552**
DEARBORN, W. F., **445**
FREEMAN, FRANK N., **233**
GILLILAND, A. R., **201**
GODDARD, HENRY H., **231**, **287**, 436
GOLD, HUGO, **459**
GRAVES, S. MONROE, **483**
HAINES, THOMAS H., **143**, **234**
HEALY, WILLIAM, **238**, 434
HEILMAN, J. D., **337**
HILLIARD, GEORGE H., **400**
HOLLEY, C. E., **495**
HOLLINGWORTH, H. L., **278**
KALLOM, ARTHUR W., **226**
KELLY, F. J., **63**
KELLEY, TRUMAN LEE, **1**, **111**
Kendall, Calvin N., 295
KING, IRVING, **459**
KITSON, HARRY D., **279**
KUHLMAN, F., **280**
MEAD, A. R., **495**
MEAD, CYRUS D., **261**
MELVILLE, NORBERT J., **429**
MILES, WALTER R., **329**
MINER, J. B., **282**
Mirick, George A., 295
Mitchell, David, 287
MURPHY, HERBERT HAYES, **150**
MYERS, GARRY C., 294, **546**
PAINTER, W. S., **25**
PETERSON, JOSEPH, **523**
PHILLIPS, FRANK M., **271**
PINTNER, RUDOLF, **201**
PYLE, W. H., **278**
REDFIELD, CASPER L., **548**
RIETZ, H. L., **87**
ROOT, WILLIAM T., **533**
Sandwick, Richard L., 294
SEARS, ISABEL, **261**
Sears, J. B., 295
SEASHORE, CARL E., **81**, **163**, **229**, 241
STARCH, DANIEL, **213**
STEWART, S. F., **414**
STOCKARD, L. V., **567**
SWEET, ITASCA B., **39**
TERMAN, LEWIS M., **348**
THORNDIKE, EDWARD L., **509**
TOWN, CLARA HARRISON, **351**
TRABUE, M. R., **427**
WALLIN, J. E. WALLACE, **17**, **353**
WATSON, EMERY E., **223**, **607**
WHIPPLE, GUY MONTROSE, 297, 298, **357**, 434
WINCH, W. H., **93**
WOOD, LOUISE, **593**
WOOLLEY, HELEN T., **431**
YERKES, ROBERT M., **593**

INDEX TO SUBJECTS

Addition Test, 535
Ancestors of Eminent Men, 548
Appreciation, Esthetic, 509
Arithmetic, 213, 223, 261, 271
Artistic Endowment, 498
Attitudes, Effect of on Learning, 523
Auditory Discrimination, 81
Binet Tests, 552
Blind, 81, 143
Bright Child, 241
Coefficient of Intelligence, 593
College Students, 129, 223, 381
Completion Test, 329
Constructive Ability, 1, 445
Correlation, 87
Courtis Tests, 223
Defects of Speech, 581
Division, 261
Educational Measurements, 213, 223, 261, 271
Educational Meetings, 167
Educational Psychology, 46, 337
Eminent Men, Ancestors of, 548
Esthetic Appreciation, 509
Exceptional Children, 287
Fatigue, 25, 533
Formal Discipline, 31, 87, 361
Form Board, 17, 445
Freshmen, 129, 381
Geometry, 567
Handwriting, 483
Intelligence, Coefficient of, 593
Invention, 1
Law, 87
Learning, 150, 523, 548
Mathematics, 87, 223
Memory, 31, 523
Mental Fatigue, 25, 533
Mental Tests, 1, 17, 81, 129, 143, 163, 187, 229, 278, 317, 329, 348, 381, 400, 427, 445, 459, 509, 533, 552
Multiplication, 25, 533
Music, 440
Numerals, 226
Opposites, 459
Originality, 317
Physical Growth, 414
Physiology, The New, 557
Point Scale, 143,
Porteus Tests, 552
Practice, 31, 85, 150, 271
Practice Teaching, 495
Psychological Meetings, 111
Psychology in the Schoolroom, 337
Quality of Poetry, 509
Reading, 39, 63, 201
Reaction Time, 226
Reasoning, 187
Recall, 548
Reproduction, Immediate and Delayed, 523
Scales, 143, 213
Scheiner's Experiment, 540
School Standing, 314
Social Sciences, 116
Speech Clinic, 253
Special Defects, 581
Spelling, 93
Subtraction, 261
Throwing a Javelin, 150
Transfer of Training, 31, 87, 93, 361
Visual Discrimination, 539
Writing Numerals, 226

IMPORTANT NOTICE: CHANGE OF PRICE ON JAN. 1.

The Perry Pictures



LOST

(The One Cent Size is 12 to 15 times as large as this picture.)

Send 25 Cents for

25 Madonnas, or 25 Art Subjects or 25 for children, or 25 kittens, etc., each 5 1-2 by 8, or $1.00 for the 4 sets. (After Jan 1, the 4 sets will cost you $1.50.) ORDER NOW.

OCTOBER 5, 1916.

The last time we bought Kraft wrapping paper we paid less than $80.00 a ton for it. Today it is $180.00 a ton.

The market price of the paper on which all of the Perry Pictures are printed was 8 cents a pound. Today it is nearly double that price.

After January 1, 1917, the price of the One Cent Size [5 1-2 by 8] Perry Pictures will be A-CENT-AND-A-HALF EACH; 20 for 30 cents; $1.50 Per 100.

Until then you can buy as many as you want at One Cent Each for 25 or more: $1.00 per hundred.

SUNSET GLOW

Send $1.00 for

Beautiful Art Set of 100, each picture 5 1-2 by 8, and all selected by Mr. Perry himself. A very beautiful set. (After Jan. 1, it will cost $1.50 instead of $1.00.) From it you can make 4 choice gifts of 25 pictures each.

Order today. Use them for Christmas Gifts. Teach the Christmas Story with them.

Until Jan. 1. One Cent Each FOR 25 OR MORE. POSTPAID SIZE, 5 1-2 x 8. 2250 SUBJECTS $1.00 PER HUNDRED

After Jan. 1. A-Cent-and-a-Half Each for 20 or more; 20 for 30 cents: $1.50 per hundred.) Send 25 Cents for Booklet, MADONNAS.

Bird Pictures in Natural Colors. 2 Cents Each for 13 or more. Size, 7 x 9.

CATALOGUES

64-page catalogue of 1600 miniature illustrations for 5 two-cent stamps. [Please do not send for the Catalogue unless you send the stamps.]

MONARCH OF THE GLEN

Order NOW February Pictures of Washington—Lincoln—Longfellow. A cent each now—$1.00 per hundred. A saving of 50 cents on every hundred.

Give each pupil a beautiful Perry Picture for a Christmas Gift

Do no wait a single day before ordering, we shall be very busy with orders in December.

THE PERRY PICTURES COMPANY

Box 503 Malden, Mass.

AGE OF INNOCENCE

HERE'S A SIMPLE, CONCISE, UP-TO-DATE TEXTBOOK IN PSYCHOLOGY

THE crowded time-table of the modern teachers' training school does not, as a rule, admit of a long course in experimental psychology, and during the hours which are available it is desirable that the students should be occupied, as far as possible, in the actual carrying out of experiments in class under the oral instruction of the teacher, or in discussing their results. In this moderate-length text an account is given of a number of psychological experiments which bear directly upon educational problems and on the work of the teacher in the school. All the experiments described can be carried out without any apparatus except such as can easily be made with pen and paper. Both as to size of text, then, and also as to the scope of experiments, this book is especially adapted for use in schools and colleges that are engaged in the training of teachers. While the book has been prepared for a classroom text, its possible use by the individual who must pursue his studies without the guidance of a teacher has been kept in mind by the author. The private student should be able to carry out all the experiments here described in his own room.

INTRODUCTION TO EXPERIMENTAL PSYCHOLOGY

By C. W. Valentine

194 pages, $1.10

WARWICK & YORK, Inc., Publishers : : BALTIMORE, MD.

FORTHCOMING ARTICLES

The

JANUARY

NUMBER

of the

Journal

of

Educational

Psychology

will contain

the following

Articles

GRACE E. BIRD, Rhode Island Normal School. *Pupils' Estimates of Teachers.*

Three hundred and ninety-two high school pupils and one hundred and fifty normal school students were asked to write out the five or six best qualities of the best teachers they had ever had. The article gives the distribution of the judgments and the correlations between the groups.

EDWARD S. JONES, Chicago, Ill. *The Woolley Test Series Applied to the Detection of Ability in Telegraphy.*

Twenty-two boys were given the Woolley tests at the beginning and at the end of judgment of their teachers on their ability as telegraphers By grouping selected tests a correlation of .81 was secured.

N. J. BOND AND W. F. DEARBORN, Harvard University. *A Comparison of the Auditory Memory and Tactual Sensibility of the Blind with Those of Persons with Normal Vision.*

A class of 19 pupils in a school for the blind was tested in the reproduction of a story, the retention of the story for five days, immediate memory for letters and figures, and a complicated form-board test, and the results were compared with those obtained from grammar school, high school, and college students. The blind pupils showed a distinct superiority in logical memory, a slight advantage in retention, no difference in memory for letters and figures, and more than twice as much skill with the form-board.

MARGARET V. COBB, Laboratory of Social Hygiene, New York, N. Y. *A Preliminary Study of the Inheritance of Arithmetical Abilities.*

A careful study of the arithmetical abilities of parents and children in eight families examined by the Courtis tests yielded convincing evidence of the inheritance of mathematical ability. A child of either sex may resemble either parent, but one only. If children are compared with like parents the correlation is .60, but if with unlike parents it is only .01.

35 cents per issue

$3.00 a year

Published by

WARWICK & YORK, Inc.

LANCASTER, PA. **BALTIMORE, MD.**

Recent Publications

— of —

WARWICK & YORK, Inc.

THE PSYCHOLOGY OF DRAWING

By Fred C. Ayer

172 pages, $1.25

The laboratory method has come to be practically universal in the teaching of science. The process of drawing is everywhere esteemed as a most significant form of laboratory methodology. To some degree in the physical sciences, but more especially in the biological sciences, the amount of time devoted to making pen and pencil drawings is a major part of the laboratory procedure. Many pupils encounter great difficulty in making the required drawings. They either make poor drawings or consume a disproportionate amount of time in the effort to make good ones. Because of this, many receive low grades, are discouraged, and discontinue their work in the field of science. The widespread use of a teaching device which consumes extended periods of time in all cases, and fails to meet the needs of individual pupil in many cases, raises an important problem. Laboratory work has three aims: the observation of material, the making of records, and the retention of learning. It furthers these aims by three devices: representative drawing, description, and analytical drawing. In the "Psychology of Drawing," Dr. Ayer undertakes to determine the character of the various interrelations of the factors which enter into laboratory procedure. The text includes a survey of the existing literature of the psychology of drawing. An attempt is made to characterize the chief contributions to the psychology of drawing and to organize the results of the important studies in such a manner as to afford students of the various aesthetic, economic, and scientific aspects of drawing a scientific point of departure.

THE EXPERIMENTAL DETERMINATION OF MENTAL DISCIPLINE IN SCHOOL STUDIES

By Harold O. Rugg

150 pages, $1.25

The problem of mental discipline, of determining under what conditions, by what methods and to what extent training received in a given line of mental activity spreads to other lines of mental activity, is acknowledged to be the central problem of educational psychology. The answer that experimental investigation affords to this problem is acknowledged to possess a most significant bearing upon several cardinal problems in education. The arrangement of the curriculum, particularly in the high school, the designation of prescribed courses in both high school and college, the selection of methods of instruction in various subjects—all these things depend in part upon what we know about the nature of mental discipline.

Dr. Rugg's monograph claims attention for two reasons especially: (1) it presents in a compact semi-tabular form a valuable and comprehensive summary of all the experimental work that has been done upon formal discipline to date; (2) it presents the results of the author's own investigation, which is conspicuous because it deals with a large number of subjects (students in the University of Illinois) and because it measured the effect upon mental efficiency produced by a course of instruction (descriptive geometry) carried on under regular classroom conditions. The demonstration of a certain degree of transfer of training is of real importance both in theory and practice.

THE STUDY OF THE BEHAVIOR OF AN INDIVIDUAL CHILD

Syllabus and Bibliography.

By JOHN T. MCMANIS

64 pages, paper binding 60c, cloth binding 75c.

This work consists of directions for the study of the child in his various relations in the home, in school, and at play. Suggestions are made of the different lines of interest to be studied in order to understand the child just as might be done in the scientific study of any living creature. Physical conditions, home environment, outside activities, play, instinctive reactions, school life, mental and moral characteristics, learning abilities, and special capacities are analyzed and suggestions given for study. The author's work in connection with the Department of Education at the Chicago Normal School has enabled him to understand just what information the teacher who would be successful in the training of children should possess regarding the child as an individual, and his text profits by his experience in classroom in developing and improving his themes. A classified bibliography of books and articles accessible to teachers and students in training classes accompanies each outline of study.

THE GENERAL VALUE OF VISUAL SENSE TRAINING IN CHILDREN

By CHANG PING WANG

96 pages, $1.00.

In a way, one who announces formal discipline as his topic may be expected to offer an apology, so much has been written and so much valuable experimental work has been done on the problem during the last ten years. But even though numerous investigations have been made to test the general effects of the training of specific mental functions, and even though many educators seem to regard the nature of these effects as quite well established, there is at present no general agreement among authorities as to the range, the amount and the means of "transfer" in any single mental function. Furthermore there is special need in the work on this problem for standardization of methods both in experimentation and in the calculation of results.

In this study Dr. Wang, a Chinese Government student, reports the results of experiments he conducted in the departments of education and psychology at the University of Michigan. These experiments, one extended and two others relatively brief, performed under carefully controlled conditions, show in detail the specific and general values of certain types of visual-sense training in children, for the most part ten years of age.

This little volume should be of special interest to every student in experimental education, the most important single movement in all pedagogy.

WARWICK & YORK, INC.

EDUCATIONAL PUBLISHERS

BALTIMORE, MD.

Educational Administration and Supervision

ANNOUNCEMENTS

Among the forthcoming articles will be the following

The Need of a Scientific Curriculum Policy for Junior and Senior High Schools. Principal Jesse H. Newlon, Lincoln, Nebraska.

Provision for the Gifted Child. Elizabeth L. Woods, Pasadena public schools, California.

The High School and Modern Citizenship. Charles Hughes Johnston, Professor of Secondary Education, University of Illinois.

The Reorganization of English in the Secondary Schools. Professor James F. Hosic, Chicago Normal College, Chicago.

High School Failures. Superintendent Don C. Bliss, Montclair, N. J.

Research Work in Arithmetic. S. A. Courtis, Supervisor of Research, Detroit, Michigan.

$2.50 a Year. **30c Per Issue.**

WARWICK & YORK, INC.

PUBLISHERS

LANCASTER, PA. **BALTIMORE, MD.**

CONTENTS

VOL. VII, No. 10. DECEMBER, 1916.

L. V. STOCKARD AND J. CARLETON BELL. *A Preliminary Study of the Measurement of Abilities in Geometry* . . 567

SMILEY BLANTON. *A Survey of Speech Defects* 581

ROBERT M. YERKES AND LOUISE WOOD. *Methods of Expressing Results of Measurements of Intelligence: Coefficient of Intelligence* 593

COMMUNICATIONS AND DISCUSSIONS:

The College Freshman and Mathematics. Second Report. (E. E. Watson) 607

Measures of Difficulty in Completion Tests. (J. Crosby Chapman) 609

EDITORIAL 611

NOTES AND NEWS 613

PUBLICATIONS RECEIVED 615

Index for Volume VII (1916) is bound between the advertising sections and the reading pages of this issue.

INCHES
1
2
3
4
5
6
C2399
METRIC
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15